ISIS

International Review devoted to the History
:: of Science and Civilization ::
Quarterly Organ of the History of Science Society and of the International Academy of the History of Science.

SUMMARY
of No. 64 (Vol. XXII, 2)
111 p., 7 pl., 20 p. facsimile

I. — *Carnegie Institution of Washington. Division of historical research. Section of the history of science. 16th annual report* (July 1, 1933 to June 30, 1934) 435

II. — *Main articles* (6)

SARTON, G. *(Cambridge, Mass.)*. — Preface to volume XXII. Lusitanian memories (1 pl.) 440

THOMPSON, D. V., jr. *(London)*. — Medieval color-making: *Tractatus qualiter quilibet artificialis color fieri possit* from Paris, B. N., MS. latin 6479 *b* 456

POGO, A. *(Washington, D. C.)*—GEMMA FRISIUS, his method of determining differences of longitude by transporting timepieces (1530), and his treatise on triangulation (1533). (With 4 pl. and a facsimile reproduction (no. XVI) of GEMMA's *Libellus de locorum describendorum ratione*, Antwerp, 1533). 469

HAMOR, W. A. *(Pittsburgh, Pa.)*.—DAVID ALTER and the discovery of spectrochemical analysis (1 portr.) 507

STANTON, S. Mc C. *(Ann Arbor, Mich.)*.—The Admiral's map. What was it? And who the Admiral? 511

SOROKIN, P. A. and MERTON, R. K. *(Cambridge, Mass.)*—The course of Arabian intellectual development, 700-1300 A.D. A study in method 516

III. — *Notes and Correspondence* (6)

Query no. 46 : Sleeping along the meridian.—*Query no.* 47 : Prehistoric representation and conception of pregnancy(1 pl.). —The study of the history of astronomy in Bamberg.—Unity history school, Rome 1935.—Prix Binoux, 1934.—Personalia 525

IV. — *Reviews* (8)

IInd Century. PTOLEMY. — Geography translated into English and edited by E. L. STEVENSON. Introduction by J. FISCHER. New York Public Library, 1932 (A. DILLER) . . . 533

XIIth Century. MEYERHOF, M.—Al-morshid fi'l-kohl, ou le guide d'oculistique de AL-GHĀFIQĪ. Barcelone, 1933. (G. S.). 539

XVIIth Century. BROWN, H.—Scientific organizations in XVIIth cent. France. Baltimore, WILLIAMS & WILKINS, 1934 (J. PELSENEER) . . . 542

WOLFSON, H. A.—The philosophy of SPINOZA. Harvard Univ. Press, 1934 (L. HARAP) 543

Philosophy of Science. MEYER, A.—Ideen und Ideale der biologischen Erkenntnis. Leipzig, BARTH, 1934 (E. WOLF) 546

History of Civilization. MUMFORD, L.—Technics and civilization. New York, HARCOURT, 1934 (H. T. DAVIS) 548

Logic. PEIRCE, C. S.—Collected papers of C. S. PEIRCE. Vol. IV, Harvard University Press, 1933 (W. V. QUINE) 551

Mathematics. SMITH, D. E. & GINSBURG, J.—A history of mathematics in America before 1900. Chicago, Open Court, 1934 (F. E. BRASCH) 553

V. — *Forty-first Critical Bibliography of the History and Philosophy of Science and of the History of Civilization (to April 1934) 345 items contributed by 6 scholars* 557

Carnegie Institution of Washington. Division of historical research. Section of the history of science.

Sixteenth annual report for the period extending from July 1, 1933 *to June* 30, 1934 *(Previous reports appeared in* YEAR BOOKS *of the Carnegie Institution, no.* 18 *to* 32, 1919 *to* 1934; *the* 12*th and following also appeared in* ISIS, *the latest in vol.* 21, 5-7, 1934*)*

1. *Generalities.*—From June 15 to December 31, Dr. POGO took a long postponed vacation. Dr. SARTON was obliged to interrupt his work from Nov. 24 to Dec. 28 because of accumulated anxiety and fatigue; he travelled and found rest in the West Indies, chiefly Jamaica. On June 20, he sailed from Brooklyn, N.Y. to Norway to spend the summer in Scandinavia, Belgium and England. The purpose of that trip is largely rest and recreation but Dr. SARTON will take advantage of it to study the Scandinavian museums, with special reference to their mediaeval and oriental contents. For example, many archaeological evidences of Muslim trade have been found in northern Europe. He also hopes to obtain additional information on the development of science in Scandinavia during the fourteenth and fifteenth centuries, for in spite of his investigations carried on during many years in various ways the results thus far obtained are disappointingly meager. How is it that scientific studies did not develop more rapidly in the Scandinavian countries during these two centuries after having given such fair promise in the thirteenth century and before? Did the Hanseatic league not help the diffusion of scientific ideas? On the other hand how shall we account for the mutual attraction between the Northern countries of Europe and the Orient? These are the main problems

which he will try to solve in addition to meeting a few scholars, renewing contacts with others, and collecting every available information concerning the history of science in Scandinavia throughout the ages.

2. *Introduction to the history of science.*—Dr. SARTON is continuing the preparation of the third volume of his *Introduction*, which will be exclusively devoted to the fourteenth century. That century has been somewhat neglected by historians, as compared with the thirteenth which witnessed the apotheosis of the mediaeval church, the checkmate of the Crusades, and yet the final triumph of Christianity over Islam, or as compared with the fifteenth century which was lovingly investigated by all the students of the Renaissance. There does not yet exist any general survey of science and culture in the fourteenth century.

Dr. SARTON has devoted his main effort to the analysis of Jewish contributions, while Dr. WELBORN has continued her correction and amplification of the notes devoted to Christian physicians and historians. Dr. POGO prepared additional notes concerning sixteenth century travellers, scientists and scholars.

3. *Other investigations.*—As a first installment of a series of memoirs on the pioneers of the history of science, Dr. SARTON had made an elaborate study of the life and works of JEAN ETIENNE MONTUCLA (1725-99), the first great historian of mathematics. He has continued throughout the year his Arabic exercises, reading as much Arabic as possible, either silently alone or else aloud with a Syrian tutor, and is now conducting in that language the bulk of his correspondence with Oriental scholars.

During his vacation Dr. POGO prepared a critical edition of the *Verdadera relacion de la conquista del Peru*, by FRANCISCO DE XEREZ (Sevilla, 1534) with an elaborate introduction. After his return his time was divided between his sixteenth century investigations, *Isis*, and research on early Egyptian astronomy. He has prepared a memoir on three hitherto unpublished Asyut calendars. On March 26 his office was transferred from Cambridge to Washington, and since then most of his time has been devoted to Maya astronomy.

Dr. WELBORN completed her memoir on DINO DI GARBO's metrology, already mentioned in the previous report. This is the first of a series of intended studies on mediaeval weights

and measures. She has investigated MONDINO DE LUZZI's commentary on the *Canones generales* of MESUË the Younger.

Dr. PHILIP SHORR spent a part of the winter in Cambridge and during that time completed a very interesting study on the genesis of prehistoric research.

4. *Edition of Isis.*—Dr. SARTON has edited with Dr. POGO's assistance five numbers of *Isis* (56 to 60) forming the second half of vol. 19, the whole of vol. 20, and the first third of vol. 21, a total of 1160 pages, with 21 plates and 9 figures. These five numbers contain 34 memoirs, 34 shorter items, 56 reviews, and 1930 bibliographic notes. To appreciate these figures it is well to compare them with those included in previous reports.

The growing success of *Isis* had led to a very difficult situation. In spite of the fact that the present capacity of *Isis* is more than double its original one, a large number of MSS. have accumulated at the printer's and in the editor's offices, and the editor is now obliged to turn down an abundance of good material which would deserve publication. The only remedy seems to be the creation of a new series—tentatively called *Osiris* (see *Isis* 19, 7-8, 1933)—which would accommodate the papers which are too long for *Isis* (say, more than 10,000 words) and yet too short to stand on their own feet. Protracted negotiations with the History of Science Society have failed, but the editor is determined to continue them with other bodies. He has already obtained some temporary help from the National Academy of Sciences, but he is looking for a permanent solution. There does not seem to be any other than the creation of a new series, as is confirmed by the experience of every learned society and academy. Longer papers are unavoidable, for the account of elaborate investigations cannot be abridged beyond a certain point, and are seldom of sufficient length to justify the publication in book form, which is wasteful and too expensive for the publisher as well as for the prospective buyers. Yet short papers and longer memoirs should not be published in the same journal, for the latter do not simply mortgage a large part of the journal's capacity, but they go far to destroy its attractiveness to all readers except the very few who happen to be interested in the very subjects of those memoirs. The supremacy of *Isis* in its field

and its economic soundness cannot be safely maintained without the creation of a parallel series, such as *Osiris*.

5. *Lectures*.—Dr. SARTON gave a course of 33 lectures at Harvard University on the history of science in the eighteenth and nineteenth centuries, and a course of 33 lectures at Radcliffe College on the history of mathematics. In addition to those two courses, he delivered a lecture on " The study of the history of mathematics" at the joint session of the Mathematical Association of America and the mathematical section of the American Association for the Advancement of Science, in Cambridge, Mass., Dec. 29; and another lecture on " Mediaeval science and culture " at the Carnegie Institution, in Washington, D.C., on February 27.

6. *Staff*.

(JOHN C. MERRIAM, President of the Carnegie Institution.
A. V. KIDDER, Chairman of the Division of historical research.)
GEORGE SARTON.
ALEXANDER POGO.
MARY CATHERINE WELBORN.
FRANCES SIEGEL, Secretary.

Bibliography

POGO, ALEXANDER. Earliest diagrams showing the axis of a comet tail coinciding with the radius vector. *Isis* 20, 443, 2 pl., 1934.

SARTON, GEORGE. Second preface to vol. XIX (Beirût). *Isis* 19, 322-9, 1933.

— Thirty-sixth critical bibliography of the history and philosophy of science and of the history of civilization (to October 1932). *Isis* 19, 379-470, 1933.

— Thirty-seventh critical bibliography of the history and philosophy of science and of the history of civilization (to December 1932). *Isis* 19, 521-619, 1933.

— The teaching and study of the history of science at the University of California. *Isis* 20, 6-14, 1933.

— Arabic " commercial " arithmetic. *Isis* 20, 260-2, 1933.

— Hippocratic oath in Arabic. *Isis* 20, 262, 1933.

— Orientation of the miḥrāb in mosques. *Isis* 20, 262-4, 1933.

— Le prospectus de l'Encyclopédie. *Isis* 20, 264-5, 1933.

— Introduction of cacti and other Cactaceae in Europe. *Isis* 20, 442, 1934.

— Thirty-eighth critical bibliography of the history and philosophy of science and of the history of civilization (to March 1933). *Isis* 20, 506-626, 1934.

— The artificial fertilization of date-palms in the time of ASHUR-NASIR-PAL, B.C. 885-860. *Isis* 21, 8-13, 4 pl., 1934.

— JEAN TRENCHANT, French mathematician of the 2nd half of the 16th century. *Isis* 21, 207-9, 1934.

— ADRIAAN VAN ROOMEN's commentary on AL-KHWĀRIZMĪ (c.1598). *Isis* 21, 209, 1934.

— Primitive tonsillotomy. *Isis* 21, 209, 1934.

Preface to Volume XXII

LUSITANIAN MEMORIES

I am writing these lines on board the good ship Transylvania, sailing from Liverpool to New York, after a vacation of a fortnight in one of the most beautiful countries of Europe—Portugal. A country beautiful in her present state and even more so if one can see her in the perspective of her glorious past, for our aesthetic pleasure even as our mathematical understanding of the world cannot be complete in a tridimensional space; we need at least one additional dimension which enables us to see things in the flux of reality.

My visit to that glorious country was brought about by the Third (1) International Congress of the History of Science, which began in Oporto on September 30, continued in Coimbra and ended in Lisbon on October 6. Thus even while they were discussing their favorite ideas, members of the Congress were making, so to say, a cross section of the heart of Portugal, and could admire some of her artistic treasures and contemplate her landscapes, ever changing but always beautiful and impressive. A complete account of the Congress will eventually appear in *Archeion*, and proceedings will probably be published in the fullness of time by our Portuguese colleagues; my purpose is simply to record my impressions and to express my gratitude to our generous hosts.

***

I had arrived in Lisbon a week before the opening of the Congress in order that I might accustom myself a little to the country

(1) The first Congress had taken place in Paris, 1929; the second in London, 1932.

and to the language. As far as the former was concerned, I achieved my aim. In spite of the destruction caused by the terrible earthquakes of Nov. 1, 1755 Lisbon is one of the most picturesque cities of Europe. Her most famous son, LUIZ DE CAMÕES, was well inspired when he said

E tu, nobre Lisboa, que no mundo
Facilmente das outras és princeza.

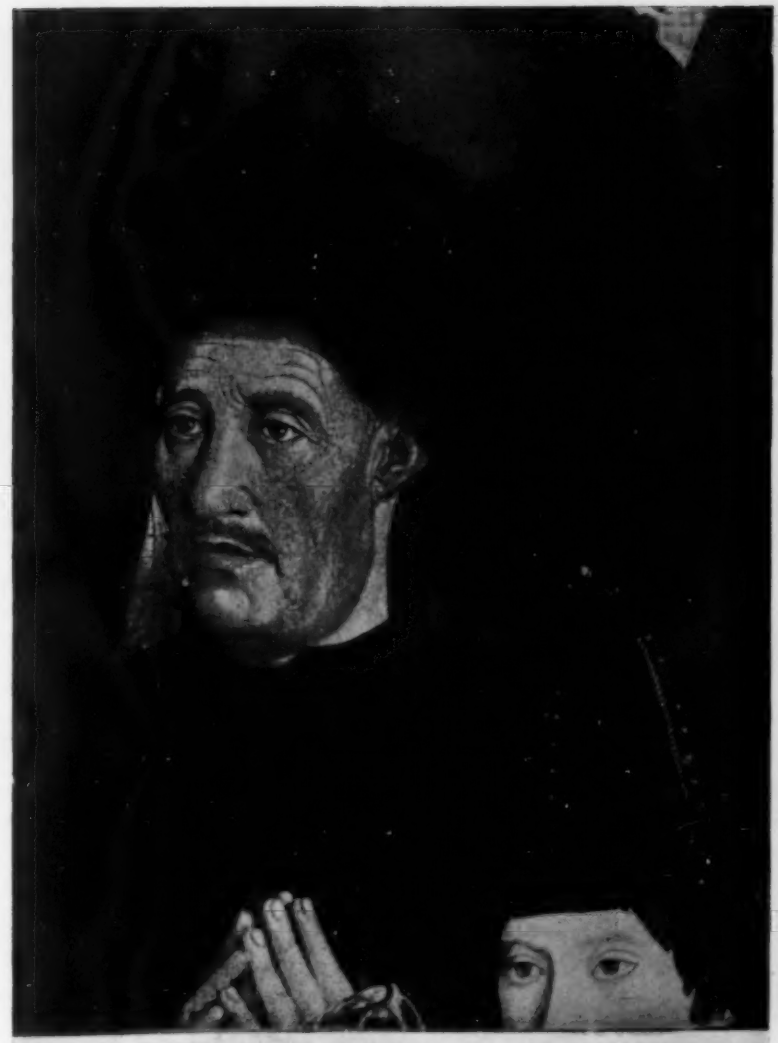
I was initiated to its splendour on the day of my arrival by Prof. ALDO MIELI, Mmes. METZGER and BESSMERTNY; together we crossed the Tagus twice, had ourselves lifted up to various heights to view the city from different angles, and finally drove to Belem and paid our respects first to VASCO DA GAMA and CAMÕES, then to ALMEIDA-GARRETT and ALEXANDRE HERCULANO. A good beginning indeed! On another day I visited the older part of the city, which hugs the hill topped by the castle of Saint GEORGE *(castelo de São Jorge)*. That quarter did not suffer much from the earthquake and one can still see enormous walls, parts of which are Moorish, and possibly even Visigothic. It was my privilege to be taken around the old city and inside of the military barracks which crown it, by the best of guides, Col. DA COSTA VEIGA, director of the National Library. Together we stopped at many of those terraces—for example, the *Mirante de Santa Luzia* so gracefully decorated with Moorish gardens and fountains, and we admired the various panoramas of the city, of the majestic Tagus and of the mountains beyond. Lisbon was built on many hills dominating two great valleys perpendicular to each other, the one being the river valley and the other (north of the river) the main axis of the city development; all of those hills are covered with houses and gardens, many boast churches and other monuments, and it thus is easy to imagine what unexpected and wonderful prospects are constantly opening in every direction. At almost every turning of the upper streets one may look forward to a new revelation of the Queen of the Tagus. One of the most beautiful vistas I obtained from the upper floor of the American Legation, where I was kindly taken by our learned minister, Dr. ROBERT GRANVILLE CALDWELL. He showed me from his windows the location of the two Muslim forts which dominated the Tagus and secured the city. I may

recall that the Muslim domination lasted from 711 to 1147, that is, more than four centuries, and Moorish influence continued to be felt for centuries afterwards. AFFONSO HENRIQUES had already conquered a large part of northern Portugal when in the year 1147 he obtained the assistance of a fleet of German, English and Flemish Crusaders on their way to Palestine under the supreme command of the Fleming ARNULF VAN ARSCHOT. Combining their forces, they finally reduced the city on October 21, 1147. The Flemings played a very important part in that siege; some of them settled in the country and they influenced the native Christian population in many ways.

The best proof of Flemish influence is to be found in the Museum of ancient art *(Museu das janellas verdes)* which contains among many other precious paintings, one of inestimable value, indeed one of the most precious in the whole of mankind's patrimony—the double triptych of São VICENTE, Lisbon's patron saint, completed about 1460 by NUNO GONÇALVES. I do not hesitate to place that triptych on almost the same level as VAN EYCK's *Worship of the Lamb* (1432); the comparison is in any case very appropriate, for it is impossible to look at GONÇALVES' masterpiece without thinking immediately of VAN EYCK and of other masters of the Flemish school, above all HUGO VAN DER GOES. The Flemish influence is overwhelming and undeniable. How was it exerted? We know too little about GONÇALVES to answer that question exactly (2). One thing is certain, JAN VAN EYCK was in the service of PHILIP THE GOOD, duke of Burgundy, and was included in the embassy sent by his master to Lisbon to sue for the hand

(2) NUNO GONÇALVES flourished c. 1450-71. He was already praised by FRANCISCO DA HOLLANDA who wrote in his *Da pintura antigua* that NUNO painted the triptych upon the order of AFFONSO V for the *Sé* of Lisbon and that he himself saw it *in situ* in 1548. However the final attribution of the triptych to him is relatively recent. It is due to the great Portuguese scholar JOSÉ DE FIGUEIREDO (*Arte portugueza primitiva: O pintor* NUNO GONÇALVES, Lisboa, 1910). Thus histories of art published twenty five years ago or earlier did not even mention him who is now recognized as one of the greatest masters of all times.

NUNO's affinities with HUGO VAN DER GOES are remarkable, but it cannot be proved that they influenced one another. They were close contemporaries, HUGO being probably the younger for he became a master in Ghent (i.e., he was admitted to the guild of painters) only on May 5, 1467, and died in 1482. Of course, NUNO and HUGO may have met in Flanders and they may even have worked in the same studio, but we do not know.



NUNO GONÇALVES

RETRATO DO INFANTE D. HENRIQUE (Detalhe do painel do Infante)

Série da «Adoração de S. Vicente»

(Museu do Patriarchado)

of the *infanta* ISABELLA, his special mission being to pourtray her. The Burgundian embassy landed at Cascaes in October 1428. It is highly probable that NUNO was then in touch with JAN VAN EYCK; it is probable that he worked with him; it is possible that he returned with him to Bruges (3).

I have insisted upon this because that triptych is exceedingly important and is bound to interest historians of science, even those who are least sensitive to art. Indeed it represents grouped around São VICENTE, King AFFONSO V, his family, and characteristic representatives of that age, the Golden Age of Portugal. The most striking figure of all is that of Dom HENRIQUE o NAVEGADOR (4) : after having contemplated that very realistic portrait, one almost feels as if one had met him in the flesh, him who was the initiator of Portuguese glory, one of the greatest men of his time and one of the greatest men of his race in all times. Moreover this gives me a new opportunity of illustrating the great value of the history of art for our own studies. Not only are beautiful objects more significant than others and hence we should always be on the lookout for them, but the transmission of ideas is more obvious, more immediately and more completely perceived in the field of art than in that of science. Hence the historian of science visiting a foreign country should be prepared to spend a considerable amount of time in its art museums. That part of my duty being particularly congenial to me, I did not fail during my first week to visit the museums of Lisbon as well as the living museum of its own streets and markets, and thus I obtained a fair introductory knowledge of the vast treasure of Portuguese culture. However, I saw nothing more beautiful or more impressive than the triptych of São VICENTE—a masterpiece which would justify by itself the pilgrimage to Lisbon.

With regard to my second aim, to familiarize myself with the Portuguese language, I must admit that I failed almost completely. I had rashly assumed that Spanish, Latin and French would help me to understand Portuguese without too much difficulty. This may be partially true of the written language, but does

(3) JAN VAN EYCK died in 1441.

(4) Another portrait of Don ENRIQUE, in the MS. of GOMES EANNES DE AZURARA's *Chronica do descobrimento e conquista da Guiné* (Bibl. Nat. Paris) was in all probability limned by the same hand about 1453.

not apply at all to the spoken one. Indeed Portuguese is much softer than Castilian,—CERVANTES called it boneless Castilian! The hard clearness of the latter has been smoothened out, its sonority muffled; the vowels have lost their purity and assumed complex sounds sometimes comparable to the English ones, many are almost inaudible; syllables are often slurred or telescoped one into the other; the consonants have lost their inflexibility and their harshness; hushing sounds seem to predominate. It is as if the whole language had been mellowed and flattened out, and the elements of its structure can hardly be recognized by an untrained ear.

***

The Congress was opened in Oporto, which was then celebrating the successful completion of its Colonial Exhibition. A sumptuous dinner was offered by the City in the main palace of that exhibition and some members were fortunate enough to witness in that afternoon a very interesting historical pageant. I was not among them alas! for having been unable to find a room in the overcrowded city, I was obliged to take up my abode at some distance outside of it, at São João da Foz, a pretty seaside resort near the mouth (5) of the Douro. In the absence of the president, our revered master Dr. KARL SUDHOFF of Leipzig, the burden of the presidency had fallen upon my shoulders and this made havoc of my freedom and peace of mind. Thus on that Sunday afternoon, instead of returning to the city to see the famous pageant, I preferred to walk along the sea shore and the beautiful esplanade of São João da Foz and keep as quiet as possible. The dinner itself I could not avoid, and I enjoyed it as much as one can enjoy one with the perspective of having to deliver a plausible speech at the end of it.

On Monday morning, October 1, the Congress was formally inaugurated at the University of Oporto, the speakers being the president of the Portuguese committee Prof. FERNANDO DE ALMEIDA E VASCONCELOS, the vice-rector of the University of Oporto, Prof. ADRIANO RODRIGUES, and myself as acting president of the

(5) Hence the name foz (Lat. fauces).

Congress. The first two spoke in Portuguese, myself in French. I may mention here that I was obliged to conduct all the proceedings in French, this being the only language intelligible to the whole audience. Soon after the completion of those uneschewable ceremonies the members of the Congress were taken together with their Portuguese hosts and friends to the left bank of the Douro to be officially received by the city fathers of Vila Nova de Gaia, the industrial suburb of Oporto, famous all the world over for the warehouses *(armazéns)*, many of them dug out of the rock, which contain the noble wines of the Alto Douro (the authentic "Porto wines"). From the municipality we drove to the Monte da Virgem whence the glorious panorama of city, river, hills and sea could be admired; then back to Gaia for a most delightful luncheon in an exquisite setting, the circular cloister of Nossa Senhora da Serra do Pilar, which is said to be one of the best examples of the Portuguese Renaissance. Did I say that HENRY THE NAVIGATOR was a son of Oporto? At any rate I could not forget it all the time I wandered in that old city—the very one whence the whole country took its name (6). Everybody knows this in Porto and in the province of Minho. I thought of it all the time, even while I was walking along the narrow streets below the Sé, flattening myself once in a while against the walls to make room for an oxcart—how dignified the silent oxen, and how beautiful their *cangas* (yokes)!—or later while I was visiting one of the caverns where they store the liquid gold of the Alto Douro, or even while I was respectfully sampling it...

***

The real business of the Congress began in Coimbra on the following day, and a better place for it it would be hard to find anywhere. Coimbra is the Oxford of Portugal. It is true that its university was born strangely enough in Lisbon (the *estudos geraes* founded by King DINIZ and NICHOLAS IV in 1290)—Col. da COSTA VEIGA pointed out its site to me not very far from St. GEORGE's castle—but it was soon moved to Coimbra, and

(6) The old Suevian city was called Portucale. Its name was gradually extended to the growing territory reconquered from the Moors.

in spite of many vicissitudes, Coimbra has continued to be throughout the centuries the intellectual center of the country (7). It is a noble city which I would have liked to explore more completely, but my congressional duties left me no time except for a superficial acquaintancy. Superficial does not mean fugitive, and however long I may live I shall never forget its quaint and precipitous streets, its monumental university dominating the whole town—houses, palaces and churches—like an intellectual citadel,—above all, the waters and sands of the Rio Mondego. That wide river of which the stream of water occupied at that season a very small part only, gave to the Coimbra landscape an indescribable touch of austere grandeur. How well do I understand the students' love of the Mondego, and of the soft plains around it! Is not the Mondego the greatest teacher of Coimbra? I wish I could have spent as many days or months, as I spent hours, contemplating that melancholy and pathetic landscape, the noble and sweet river, the oxen working patiently in the middle of its bed... It was very hard indeed to drag myself away from it and climb to the top of the sacred hill, in order to work instead of dream. As far as business went, the Coimbra meetings were far better arranged than the Oporto ones, this being largely due to the active secretary, Dr. ALBERTO PESSOA, assisted by two charming young ladies, respectively his daughter and his niece. The main papers were read as usual in sectional meetings, two of which were of special importance. The first of these was a deliberation on the *Corpus medicorum arabicorum*, the second a debate concerning the study and teaching of the history of science. On the latter occasion the main speakers were two Italians : our illustrious colleague FEDERIGO ENRIQUES of Rome who discussed the meaning and purpose of our studies, and Prof. ALFREDO PERNA, who explained the elaborate organisation of the teaching of the history of science in Italy—not only in ENRIQUES' institute (which is a kind of national seminary) and in the other universities, but also in the primary and secondary schools throughout the land. Prof. ABEL REY was unfortunately prevented by illness from attending the discussion, but very good contributions were offered by Prof. ARNOLD REYMOND of Lausanne

(7) The University was established in its present location in 1537.

and by HENRI BERR, the director of the " Centre international de synthèse " of Paris,—one of the three members of honour of our Academy and one of the most faithful attendants of this Congress in spite of his advancing age.

In addition to the sectional meetings there were two formal ones in the magnificent *aula* of the University, the main discourses being delivered in the first case by Dr. RICARDO JORGE who dealt with " Medicine and physicians in the time of the Portuguese world expansion " and in the second case by Prof. FONTOURA DA COSTA, who spoke of " The nautical science of the Portuguese in the time of their great discoveries." Professor JORGE's discourse read in French, was very interesting and I hope that it may soon be published in extenso. The second discourse was probably quite as interesting but the foreign members of the Congress had no means of judging, for it was read in Portuguese (8). An exhibition of early medical books had been arranged in the beautiful XVIIIth century library (9). Two brilliant receptions took place in the evenings, the first being offered in the incomparable frame of the University by the rector, Prof. DUARTE DE OLIVEIRA, the second being arranged by the municipal authorities.

We devoted the end of an afternoon to an excursion to the Serra do Bussaco and the forest covering its summit. According to a very good judge, the Swiss botanist ROBERT CHODAT, this is the most beautiful forest of Europe, and I can easily believe it for nowhere had I ever seen such a quantity and diversity, such a dense collection of magnificent and venerable trees : gigantic cedars of various kinds : Atlantic, Lebanon, Himalayan (deodars), cypresses, planes, chestnuts, evergreen oaks, cork oaks, various pines, etc. I have never seen such an abundance of old trees : the primeval forest was under the protection of the Carmelites and in 1643 URBAN VIII threatened to excommunicate anyone injuring the trees within the immense enclosure. In the meanwhile new kinds of trees were constantly introduced from many distant countries. The forest of Bussaco is thus the

(8) A French summary of the conclusions (4 p.) was handed out to the audience.

(9) Dr. J. DA PROVIDENCIA COSTA : Catálogo dos livros de medicina dos sécs. XV e XVI expostos, por ocasião do III Congresso internacional de historia das ciências (*Boletin da Biblioteca geral da Universidade de Coimbra*, Suplemento ao vol. XI, 64 p., Coimbra, 1934).

combination of a " national park " more than three centuries old and of a wisely administered arboretum. Apropos of this I may mention that the gardens of Portugal—of which I have seen many—are among the most beautiful in the world. I shall always treasure my recollections of them together with those of a few incomparable gardens of Andalusia, and of the gardens of Algiers and Jamaica. The Portuguese gardens are beyond praise and it tickled my Arabic heart to recognize in them so many Moorish peculiarities.

***

On Friday, October 5, the whole company left Coimbra in a fleet of motorbusses for a leisurely return to Lisbon across the beauty and glory of Portugal. It would be impossible for me to do justice to this daylong excursion in a few pages, for to make our readers realize the ever changing graces of the landscape nothing but the masterful description of an artist would suffice, and to make them realize the full meaning of the monuments which we visited it would be necessary to explain the whole history of the country. I must thus restrict myself to a few bare statements.

Our first stop was at Batalha, to visit the monastery of Santa Maria da Victoria, the masterpiece of Portuguese Gothic,—built by João I soon after the victory of Aljubarrota (1385) which insured Portuguese independence from Castille. This is the national Pantheon; it contains the tomb of the Unknown Soldier upon which the Perpetual Secretary of the Academy, ALDO MIELI, deposited a bunch of flowers in the name of us all. That sacred monument is essentially and triumphantly Portuguese, but one can detect in it many English influences (the king's wife was an English woman, PHILIPPA OF LANCASTER, daughter of JOHN OF GAUNT) and also, in the Manuelite additions, Oriental influences—not only Moorish but Hindu as well.

From Batalha we drove to the famous Cistercian abbey of Alcobaça—o mosteiro de Santa Maria, founded in the middle of the twelfth century to celebrate the reconquest of Santarem from the Moors. The long nave of the church is very impressive in its austerity, but this part of the immense buildings is less

Portuguese than Burgundian. The later parts are more typically Portuguese. We visited naturally the tombs of the immortal lovers—Dom PEDRO and Dona INEZ DE CASTRO, she the fair one who was murdered in 1355 and crowned two years later *(depois de ser morta foi rainha)*. They lay in opposite directions feet to feet in order that they may see and greet one another at the first moment of the resurrection. Their story reminds one of a Shakespearian tragedy, I could not hope to tell it as it should be told. Read *Os Lusiadas*, canto terceiro, 118-35.

Finally after a wonderful drive across country and along the Atlantic shore we stopped for luncheon at the most famous of Portuguese spas, Caldas da Rainha, whose hot sulphur springs were already exploited in the fifteenth century. Caldas da Rainha is so named after the dowager queen of João II, Dona LEONOR DE LANCASTER, who signed the constitution of the hospital in 1512. It is remarkable that those life-giving springs remained unknown to the Romans, but no Roman relics have thus far been found. It was already late in the afternoon when we tackled our luncheon and Portuguese luncheons are sumptuous and lengthy affairs, and thus very late when we were able to continue our trip to Lisbon. I have mentioned only the main objects of it: Batalha and Alcobaça, two of the most sacred places in Portugal, and Caldas da Rainha where we lunched, but we saw many other things of interest during this long journey across Beira and Estremadura. In fact I felt that we saw many more things than we could properly assimilate. It was very tantalizing to pass so rapidly in the neighbourhood of beautiful and noble sites each of which would have required days of study, or at least hours of contemplation and meditation. On such hasty trips my pleasure is marred by the feeling that whenever I try to obtain in a glance what in all justice should be only the reward of a long and reverential sojourn, I am committing an indiscretion if not a sacrilege.

Even the barest enumeration of all that we thus saw and " stole " on the way in our impious hurry would be very long, and I shall mention only three " images " which are engraved in my heart. We passed near the castle of Leiria which AFFONSO HENRIQUES wrested from the Moors in 1135 and became the main " point d'appui " in the reconquest. It was the residence of the great

King DINIZ (10), *o Rei lavrador* (1279-1325), he who planted the *Pinhal real*, the vast pine forest which protected the land against the invading dunes and later produced the abundant timber needed to maintain Portuguese sea power. The main keep of Leiria was built by Dom DINIZ in 1324 and a great part of the castle dates only from the same fourteenth century.

My second vision is that of Obidos, a fortified city capping a hill and more remarkable than any other I had seen before, more remarkable even—so it seemed from a distance—than the marvellous city of Visby in Gothland. The original castle was one of the key bulwarks of the Moors until the middle of the twelfth century when it was taken from them, then considerably fortified during the thirteenth and fourteenth centuries. A magnificent array of embattled walls thirteen meters high, towers and aqueducts. That walled town as I saw it from below against the blue sky in a golden atmosphere will never fade from my mind.

However, my dearest vision, the most lovely thing I saw in Portugal—far humbler than any other but more pleasing to my soul—was the fishing village of Nossa Senhora de Nazaré (11). It being a feast day—the anniversary of the Republic (12)—and the Atlantic waves being rather rough, all the fishing ships, small crescent-shaped craft bearing touching inscriptions, had been drawn on the beach, and here we could review them from first to last, with all their quaint gear and appurtenances, together with all the fishermen themselves and their womenfolk—fascinating types, unlike any others we had seen before in the country, suggesting to my imagination the Phoenician sailors who may

(10) *Introduction* 2, 844.

(11) I.e., Nazareth.

(12) The Portuguese Republic was founded on October 5, 1910. The present President General ANTÓNIO OSCAR DE FRAGOSO CARMONA is in fact a dictator. The prime minister Dr. ANTÓNIO DE OLIVEIRA SALAZAR was formerly a professor in Coimbra. He seems to be a very wise and austere man, absolutely devoted to his task, and the main artisan of a new renaissance. He has realized that the main prerequisite of a sound revival was to strengthen the physical and mental health of the people. He has started a crusade for hygiene and social medicine, sports and cleanliness, which is as beneficial as it was needed. To complete this political information, I may recall that the area of Portugal (including Madeira and the Azores) is 35.490 square miles, and the population a little less than seven millions. Portugal is the fourth colonial power, its colonial empire measuring almost 799,000 square miles with almost eight and a half million inhabitants.

have been the first to colonize this beautiful bay or perhaps the distant offspring of ULYSSES (13). How delicious the *praia* (the seashore) of Nazaré, how charming also the *sitio* (14), that is, the upper part of the village, the high cliffs overlooking the ocean. A famous miracle happened there centuries ago, and thus the Sitio de Nazaré has been for a long time the center of a very popular pilgrimage. Nazaré is one of those enchanting places where nothing happened except a sacred prodigy, and of which the guidebooks hardly speak, but where one would gladly spend one's whole life.

***

An accident prevented me from attending the closing exercises at the town hall of Lisbon at the end of a long day in Cintra and Estoril. What could one say of Cintra after the effusions of SOUTHEY, BYRON, BORROW, RICHARD STRAUSS, ALMEIDA-GARRETT and others? We naturally visited the *Palacio Real* and went up to the *Cruz Alta* to enjoy the panorama, but we had no time for the *Castello da Pena* or for the *Castello dos Mouros*. The main glory of Cintra is not to be found in the castles but in the forest and gardens. These were a fitting climax to our journey. They helped us more than anything else to understand the strange Portuguese genius so full of grace and melancholy, perplexities and contradictions. It helped us to understand the *saudade* which is as typical of Portugal as *längtan* is of Sweden. It is a mixture of quiet enthusiasm with regrets and unsatisfied desires, an implicit and incurable nostalgia for things that have been and can never be again, or for things that might be if the world were different (15). How grateful and dangerous to the soul such enchanted gardens

(13) Lisbon is supposed to have been founded by ULYSSES, hence its Latin name Ulyssipolis, or Ulyssipons. A native or denizen of Lisbon was called Ulyssiponensis in Latin, Ushbūnī in Arabic.

(14) I think *o sitio* means here " the site of the miracle," the site *par excellence*.

(15) *A grande dôr das cousas que passaram* (CAMÕES).

Saudade, oh saudade amarga e crua
Numen dos ais, do pranto,
Deus que os corações sem dó, sem mágoa
Tam cruel dilaceras,
Sinto, sinto o teu ferro abrirme o peito (ALMEIDA-GARRETT).

which stir up lyrical meditation rather than the taste and the persevering will for difficult efforts. In such gardens, I am afraid, I would forever invite my soul to dream dreams, rather than my mind to think in a humble and orderly manner or my body to do things... And if we take all this into account, as we should —as well as an overindulgent and Olympian climate—how admirable the real and continued efforts of this small nation which did cut for itself such a large share in the world's history.

***

To return to Lisbon where we spent our last day, it is a very modern city, less active and aggressive than Oporto, but more cosmopolitan and perhaps more urbane. A city where one would like to live, and where one would not only live but dream, and not only dream but play, and not only play but work. Indeed Lisbon is already very hard at work in her own gentle way.

I very much enjoyed my stay in Lisbon, which reminded me in many superficial ways of Mediterranean harbors. The shops wide open to the street, the semitropical trees and flowers, the mosaics in the avenues, the pungent smells of the humbler streets (in the Alfama and Mouraria), all that brought me back to the Orient which I love so much. There are no Moorish monuments comparable to those of Spain, yet Portugal is full of Moorish relics and memories, sometimes very obvious, more often too subtle for analysis, which filled me with delight at every step : the Moorish conceptions of gardens with fountains and colored tiles *(azulejos)* and mosaics, the dances and plays (16), perhaps the music, the Moorish castles on the top of every hill, the clapping of hands to call the servants, the gentleness and courtesy of the humblest people. How much of all that is of Moorish origin I cannot tell, but the Moorish flavor of the whole is unmistakable —and very precious to me.

***

It is especially pleasant to pay homage and offer our thanks

(16) E.g., the play of " Charlemagne and the Moors " performed every year for the festival of Our Lady of the Snows (August 5) at Souto das Neves, in Minho.

to the organizers of this Congress : in the first place, the Perpetual Secretary and the other officers of the Academy, in the second place *ex aequo*, our Portuguese hosts, so generous in their own ways, and so anxious for our well-being and our approval of their beloved country.

At the business meeting of the Academy over which I had the honour to preside in Coimbra (October 2) it was unanimously voted to accept the invitation of Czechoslovakia and hold the IVth International Congress of the History of Science in Prague, 1937, and Prof. QUIDO VETTER, the well known Czech historian of mathematics, was elected president of the Academy and of that Congress. Upon the suggestion of Prof. ARNOLD REYMOND it was also tentatively decided to hold the Vth Congress in Lausanne, 1940.

***

I would suggest that in our subsequent congresses we continue and improve the practice of devoting special meetings to the discussion of definite questions under the leadership of skillful and well-informed chairmen. Other meetings would then be set apart for the discussion of individual questions but the " reading of papers " should be forbidden or restricted as far as possible. The very paper which is meant to be read is generally unfit to be listened to. The speaker must explain matters in a very different way than the writer. It is a fundamental mistake to confuse two " genres " the qualities of which are antagonistic. Finally there might be a few general and more ceremonial lectures to be given as far as possible by people who can lecture as well as write and think, and only in one of the four or five international languages. There is no point in lecturing to an international audience in a language which the majority cannot be reasonably expected to understand. It is true that from the Portuguese point of view, to deliver an academic lecture is a kind of childish rite which does not entail any correlative duty for the audience. At the ceremonial meetings of Coimbra I noticed that the lecturers did not make special efforts to speak distinctly and loud enough, and that the audience did not bother to follow them, but was more interested in its own private conversations. It was perfectly

proper for anybody in the room, even for young students, to get up at any moment, shake hands and chatter with a few friends and walk out, then may be come in again a little later. Thus the audience remained apparently of the same size, yet its composition was very different at the end of the lecture from what it had been at the beginning. Such habits are picturesque enough but should be discountenanced in international congresses, the purpose of which is to increase and purify knowledge, rather than to perform academical or magical rites.

While I am in the mood of criticizing—and I hope that my Portuguese friends will not take amiss my candor—I think that we should try later on to be as punctual as possible in our duties as well as in our pleasures. With regard to the keeping of appointments I have found that mankind can be divided into two groups : those for whom a time of appointment is an upper limit, and those for whom it is a lower limit. The former are almost always on time or ahead of it, the latter are almost unavoidably late. Our Portuguese friends seem to belong to the second group. I hope that their new renaissance so vigorously undertaken will help them to realize that for self and neighbour, for all concerned, it is better to try and belong to the former group. Indeed the consideration of appointments as upper limits is one of the essential conditions of modern life,—not to speak of the conditions of scientific work and scientific congresses.

***

By far the best results of any congress are the personal contacts which it enables each participant to make or renew. In addition to the Portuguese friends already mentioned : the rectors of the three universities, Arlindo Monteiro, Alberto Pessoa, Fernando de Almeida e Vasconcelos, Ricardo Jorge, Fernando da Silva Correia and others, the Congress gave me the opportunity of renewing my acquaintance with Aldo Mieli, Hélène Metzger, Abel Rey, Max Meyerhof and to meet friendly correspondents of long standing such as Arnold Reymond, Quido Vetter, Federigo Enriques, Alfredo Perna, Henri Renaud, Walter Adams, Petre Sergescu, and last not least, Henri Berr who

was one of the earliest sponsors of *Isis*. To meet such men in the flesh, to renew one's friendship with old friends living far away, was a great privilege indeed, and one which I appreciate above all. Each of them is enshrined forever in my Lusitanian memories, together with the exalting revelation of a magnificent country and of an original and priceless culture.

S. S. Transylvania (Anchor Line) GEORGE SARTON.
October 19, 1934.

Medieval Color-Making:

TRACTATUS QUALITER QUILIBET ARTIFICIALIS COLOR FIERI POSSIT from PARIS, B. N., MS. latin 6749[b].

In the *Appendix* to Cambridge, Gonville and Caius College, *Ms. 181*, published by DOROTHEA WALEY SINGER in her article, "MICHAEL SCOT and Alchemy," (1) there are four rules for the manufacture of blue pigments (2), and one rule for gilding (3). None of these rules is frequently met with in medieval tracts on art technology, but a few recurrences may profitably be noted. Most extensive are those in a short *Tractatus qualiter quilibet artificialis color fieri possit* contained in the fifteenth-century Paris, Bibliothèque Nationale, *Ms. latin 6749b*, fols. 61 r°-62 v°, the text of which is printed for the first time herewith. In this tract three of the Caius manuscript rules for blue appear (4), and a version of the gilding recipe (5).

Mrs MARY PHILADELPHIA MERRIFIELD was familiar with the *Tractatus*, and, though she never published the text, noted its intimate relation to certain parts of the *Segreti per colori*, Bologna, Bibl. Univ. *Ms. 1536* (6), and one instance of similarity between

(1) *Isis*, XIII (1930), 5-15.

(2) §§ 12-15. (The sixteen paragraphs of Mrs SINGER's edition of this *Appendix* are not numbered, but may easily be counted off for reference.)

(3) § 6.

(4) § 12 of Mrs SINGER's edition corresponds with § XX of this text; § 13, with § XIV; and § 14, with § II and the last part of § VIII.

(5) § 6, corresponding with § XX of the *Tractatus*. This rule may be recognized also in a short paragraph, *Sigillum aureum sive pomuz aut nux muscata hoc modo fit*, in Cambridge, University Library, *Ms. Ii.3.17*, fol. 154 r°.

(6) Formerly S. Salvatore *Ms. 165* ; edited by Mrs MERRIFIELD in her *Original Treatises...* (London, 1849), in which see pp. 344, 348, 384, and notes ; and re-edited in the ROMAGNOLI "Scelta di curiosità letterarie inedite o rare," Disp. 222, *Il libro dei colori* (Bologna, 1897).

the *Tractatus* and the *De coloribus et artibus Romanorum* of HERACLIUS (7). Only one rule in the Caius *Appendix* is common to both the *Tractatus* and the *Segreti* (8); but these works contain other material not found in the Cambridge text (9). The *Tractatus*, therefore, is in a sense intermediate between the Caius *Appendix* and the *Segreti per colori*, having more in common with each of those texts than either of them has with the other.

The relationships among these works are problematical. Save for the rules which they have in common, there is little to link the manuscripts in which they appear. The Caius manuscript was written in the thirteenth century; the Paris manuscript is dated 1481 (10); and Mrs MERRIFIELD describes the Bologna codex as " of the fifteenth century." The *Appendix* edited by Mrs SINGER is subjoined to an alchemy attributed to MICHAEL SCOT; in the Paris manuscript, the *Tractatus qualiter quilibet artificialis color fieri possit* was interpolated by the copyist, GUILLAUME LE BIGOT, between the *Liber deflorationis philosophorum* or *Liber occultationis secretorum antiquorum* of ARNAUD DE VILLENEUVE (11) and an anonymous work entitled *Lumen luminum de coloribus;* while the Bologna manuscript consists of a vast compilation of recipes, purely technological in character (12).

The rules for blue pigments found in the *Appendix* and the *Tractatus* represent most of the chief medieval inventions for

(7) *Ibid.*, I, 198, n. 1.

(8) § 14, which corresponds with §§ II and VIII of the *Tractatus*, as stated above, and also with §§ 3 and 4 of the *Segreti*, Merrifield, *op. cit.*, 344-348.

(9) §§ III and IV of the *Tractatus*, as well as § II, are parallelled by § 3 of the *Segreti;* § V, as well as § VIII, by § 4; § IX corresponds with § 27; and § X, with § 28.

(10) At fol. 72 v°: " Isti libri fuerunt scripti per me, GUILLERMUM LE BIGOT, in anno domini milesimo quadringentesimo octuagesimo primo." Can this LE BIGOT be a connection of the old *greffarius* of the Mint in Paris, JEHAN LE BÈGUE, whose collection of tracts on colors and techniques, made in 1431, is preserved in Paris, Bibliothèque Nationale, *Ms. latin 6741*? (See M. P. MERRIFIELD, *op. cit.*, I, 321.) JEHAN LE BÈGUE was born in 1368, and died in 1457.

(11) *Incipit* at fol. 59 v°.

(12) These recipes are gethered under eight headings: I. Natural blues; II. Artificial blues; III. Vegetable blues; IV. Greens; V. Lakes; VI. Mosaic golds and Gilding; VII. Vermilions (also Mixtures, Temperas, Artificial gems, Glass and Glazes) and VIII. Dyes of all sorts. The first two sections contains the only passages specifically related to the *Tractatus*.

this purpose up to the development of the turnsole clothlet (13) in the fourteenth century. The absence of this color from the Paris text suggests, though does not prove, that the manuscript from which LE BIGOT made his copy was of thirteenth—or early fourteenth—century date.) It should be noted that ultramarine, the *azurium transmarinum* or *ultramarinum* of these texts, is the criterion of excellence among blues in the Renaissance (14), and the Caius manuscript rule for making it from lapis lazuli *per pastillum* is one of the earliest descriptions of this process which have so far come to light. One other thirteenth-century rule has been published by ERNST DARMSTAEDTER, in the *Liber claritatis totius alkimicae artis* attributed to GEBER, Bologna, *Cod. lat. 164(153)* (15). A third is found in London, B. M., *Ms. Sloane 342*, fol. 132 v°, which reads as follows :

Si vis facere Azurium, accipe lapidem lazuli et tere subtilissime in mortario. Deinde mole ipsum super marmorem cum aqua ultima et completissima molitione. Hoc facto, permitte desiccari; et cum fuerit bene siccum, iterum tere et pulveriza. Deinde accipe colofoniam, et pone in patellam ferream quantitatem unam qua tibi visum fuerit, et cum pauco oleo illam liquefac; et ipsa liquefacta cola per pannum et mundifica bene; et fac ut cadat dum colatur in vas aque fere plenum. Postmodum cum baculo lingneo de aqua extrahe, et permitte exsiccari; et cum exsiccata fuerit, cum predicto pulvere incorpora bene, mediante baculo predicto. Deinde sic permittas per quindecim dies in umbra desiccari; et cum extrahere volueris, in bacino mediante aqua frigida et ductione materie cum baculo per

(13) For a summary account of this material, see D. V. THOMPSON, Jr and G. H. HAMILTON, *De Arte Illuminandi : The Technique of Manuscript Illumination* (New Haven : Yale University Press, 1933), pp. 41-43, n. 60. A recipe, *Pro tornasolio faciendo*, in London, British Museum, *Ms. Sloane 1754*, fol. 235 v°, adds to the evidence there assembled :

Recipe flores verucarie maioris tempore quo incipiunt cadere, quod est circa festum assumptionis, libras iii, vel flores blavos qui in bladis crescunt et voca⟨n⟩tur anglice boyel... Differentia est inter verucariam maiorem et minorem quod maior flores facit et nodulos similes verucis; minor vero nec florem facit nec nodulum.

(14) CENNINO D'ANDREA CENNINI, *Il Libro dell'Arte*, ed. D. V. THOMPSON, Jr, I (New Haven : Yale University Press, 1932), 34, is lyric in its praise :

Azurro oltreamarino sie un colore nobile, bello, perfettissimo, oltre a tucti i colori; del quale non se ne potrebbe ne dire ne fare quello che nonne sia piu. Et per la sua excellenzia ne voglio parlage largho, et dimostrarti a pieno chome si fa. Et attendici bene, pero che ne porterai grande honore e utile. Et di quel cholore con l'oro insieme (el quale florisce tutti lavori di nostra arte, vuoi in muro o vuoi in tavola) innogni chosa risprende.

A little farther on (*ibid.*, p. 36, l. 29) CENNINO remarks that it is a " singhular virtu assaperlo ben fare " : this at about the end of the fourteenth century.

(15) *Archeion*, IX (1928), 78, 79, § 21.

bacinum poteris extrahere azurium. Ipso extracto et separato a colofonia, lava illud cum urina vel lexivia ter vel quater. Deinde permitte in umbra[m] desiccari, et ipso sicco usui reserva. Est enim optimum.

No other thirteenth-century rule has so far come to my attention (16).

The text of the tract in Paris *Ms. latin 6749b* probably represents an abridgment of a longer work. Its full title promises a description of the manufacture and sophistication of every sort of artificial color, of the mixture of one color with another, and of the identification of the colors. Actually it deals only with the manufacture and sophistication and identification of blues, with the manufacture of white lead, minium and *lazurium* in the sense of vermilion (17), and with chrysography, argyrography and their substitutes. There is, for example, no mention of verdigris, one of the outstanding "artificial" colors; and the section on mixtures promised by the title seems to have been omitted entirely.

[*Fol.* 61 r°]. Incipit tractatus de coloribus.

[I]

Tractatus qualiter quilibet artificialis color fieri possit atque dupplari, et quomodo unus [*fol.* 61 v°] color misceri cum alio possit, et cognosci valeat, prout scio et ab aliis intellexi et audivi et expertus sum, in hoc opusculo breviter declarabo. Et primo de lazurio, tanquam nobiliori et cariori colore, incipiendum est.

[II]

Notandum est quod duplex est lazurium, scilicet naturale et artifficiale; et naturale dupplex est, scilicet transmarinum et citramarinum. Et ipsorum affinatio:

[III]

Transmarinum affinatur hoc modo. Accipitur lapis ipsius mineralis, et ignitur inter candentes prunas. Postea extingitur in

(16) THOMPSON and HAMILTON, *op. cit.*, pp. 38, 39, n. 56, provides a summary review of the chief early literary references to the preparation of ultramarine, but the origin of the process is still veiled in mystery. It seems likely that extraction *per pastillum* came into Europe in the train of Arabic experimental chemistry, but no positive evidence is available as yet.

(17) See my article, "Artificial Vermilion in the Middle Ages," *Technical Studies*, II (1933), 67, and *ibid.*, n. 25.

bono aceto, et subtilissime teritur et pulverisatur, et per pannum cribellatur. Postea ponitur in patella in qua est pastilus, ipsum bene incorporando. Postea ponitur in aqua calida, et inter manus fricatur, vel cum baculo, ut exeat lazurium affinatum valde pulcrum; et predicta aqua efficitur viridis (18) coloris. Postea colatur aqua per lineum pannum in patella ferrea bene plumbata. Postea aqua depurata effundatur, et pulvis lazurii in patella residens in umbra desiccetur, et in corio reservetur.

[IV]

Quod si non sit boni coloris, vel forsan tendat ad palorem, decoque brasiletum in pulverem redactum in bono lexivio vel aqua pura; postea col[l]a per pannum, et impone aliquantulum de allumini glacie cum tuo vero azurio iam affinato. Hoc dat bonum colorem (19), et lazu〈rii〉 pondus auget.

[V]

Modus autem componendi dictum pastillum : sic fit. Recipe de mastice libram 1, colofonie, libram 1, et de resina col[l]ata unam quintam libram, et tantum de cepo caprino sive arietino, et ii ʒ de cera virgine, et ʒ ii de vernice, et de oleo lini coclear unum plenum. Postea funde ceram et cepum in patella. Postea impone resinam et pulverem masticis et collofonie, tunc bene cum spatula incorporando. Postea tenta si satis est spissum, ponendo unam guttam in aquam frigidam (20). Quo viso, cola per lineum pannum, et serva. Quando vero ipso uti volueris, incorpora predicto pastillo tuam mineram in subtilissimam pulverem redactam. Post extrahe aqua calida mediante.

(20) This direction is amplified in the *Segreti*, § 4, *ed. cit.*, p. 347 : " Si fermatur, bene est; si non, coque ut dum firmatur."

[VI]

Sunt quidam qui de solo mastice et collofonia componunt pastillum, omissis rebus aliis supradictis (21).

(18) *Lege* indici ?

(19) See Cennino d'Andrea Cennini, *Il Libro dell'Arte*, ed. D. V. Thompson, Jr, II, *The Craftsman's Handbook* (New Haven : Yale University Press, 1933), pp. 38, 39, and *ibid.*, p. 37, n. 1.

(21) A recipe in fourteenth-century *Ms. Harley 273*, fol. 212 v°, employs a still simpler mixture : " colofoine e oille de olive... un turtel de ces deus choses."

[VII]

Notandum est etiam quod si fuerint predicte quatuor libre, debe⟨n⟩t imponi minere libre ii (22).

[VIII]

Quomodo fiat lazurium citramarinum. Sciendum est quod lazurium citramarinum (23) affinandum est per capitellum (24) et non per pastillum, quia grossum est, et ponderosum, et nullo modo extrahitur (25) pastillo nisi bono capitello sapone romano infecto (26). Et dicitur lazurium citramarinum de almania

This brief paragraph on making blue from *piere lazule* is branded at the close, *Capitulus triumphalis*.

The reference here may possibly be to a different process of separation, apparently earlier than that *per pastillum*. For examples of this see the article of ERNST DARMSTAEDTER, *cit. supra* and compare the following rule from Montpellier, *Ms. 277*, fol. 82 v°, col. 2, *ed. cit. infra*, p. 744 :

Lapis laçuli optime teratur; deinde resina pulveri admisceatur; diu agittato aqua[m], postmodum multis vicibus abluatur; in ultimo vero sapone diligenter abluatur, et usui servetur.

(22) § 15 of the *Segreti*, " El modo da incorporare la sopradicta preta pista in lo pastillo per affinarla optimamente," *ed. cit.*, p. 363, advises the use of 10 ounces of the *pastillus* for each pound of powdered lapis. CENNINO uses six ounces of pine rosin, three of mastic, and three of wax, 12 ounces in all, for each pound of the stone. (See *The Craftsman's Handbook, cit. supra*, p. 37.)

(23) Mrs MERRIFIELD corrected the reading, *azurrum ultramarinum*, of the *Segreti*, § 4, in her translation (*op. cit.*, II, 348 : " citramarine azure ") on the authority of " the Paris Ms., which appears the most correct " (*ibid.*, n. 1).

(24) DU CANGE defines capitellum as an " aqua saponis vel lexivia, aqua saponariorum, ex quo fit sapo." In the present case it is a strong solution of Roman soap in potash lye.

Mrs SINGER has kindly re-examined the word in her rotograph copy of the Caius manuscript, and come to the conclusion that *capitellum* is the correct reading there too, and not *capuellum*, as in her edition. She asks me to withdraw her gloss : " i. e. cupellation."

(25) The reading of the *Segreti, loc. cit., et non ponderosum nullo modo extrahitur*, is certainly a corruption.

(26) It does not seem to have been usual to employ a *pastillus* for purifying azurite, but this was evidently sometimes done. Azurite being, as here stated, coarse and heavy in comparison with ultramarine, is not thrown out of the resinous medium as in that primitive oil-flotation process, but remains in the plastic, from which " it cannot be extracted except with good lye tinctured with soap." The method hinted at here is described in detail in *Ms. Sloane 1754*, fol. 234 r°, v°, *Pro asuro faciendo :* the mixture of azure, suet, resin and nut oil is divided into small portions, " ita quod azura que est in pastillo bene purgatur." (That is, it is the impurities and not the blue which come off in the washing.) After washing with cold water, hot water is applied " quam diu sordes recedunt." Soap is then scraped up with the *pastillus*, and lye made from clavellated ashes

apportatum, vel de anglia, vel yspania seu lombardia (27). Affinatur autem hoc modo. Recipe lixivium de cineribus clavellatis (28) factum bene clarum, in quo dissolve saponem romanum in bona quantitate, ut sit bene viscosum; in quo pone tuam mineram in subtilissimum redactam pulverem, et ad ignem pone, et aliquantulum mitte bullire, et move cum spatula. Post paulatim effuso capitello, invenies in fundo patelle lazurium affinatum valde pulchrum. Postea lava pluries cum aqua pura, ut auferatur ab eo viscositas aceti (29), et per pannum lineum colabis (30).

is poured over these, and the *pastillus* is dissolved. After settling, the blue is separated by decantation, and washed with fresh soap and lye. This rule is supposed to apply to *lapides lazuli*, but the author qualifies these : " id est lapis minere." In conjunction with the present text, the internal evidence of his recipe points to azurite rather than to the real lapis lazuli. The stones were, of course, often confused.

(27) In the Caius *Appendix*, § 14, *lombardicum* takes the place of the adjective *citramarinum* of this text. This material is undoubtedly azurite, the native blue carbonate of copper, generally known as *azurium de Alamania*. (See *The Craftsman's Handbook*, *cit. supra*, p. 35, n. 1.)

(28) Clavellated ashes are " the dried and calcined lees of wine." See *N. E. D.*, *s. v.* " Clavellated." According to E. Littré, *Dictionnaire de la langue française*, *s. v.* " Gravelée," " malgré clavelée qu'on trouve dans un texte du xiii^e^ siècle, il n'est pas douteux que gravelée tient à gravelle." The forms *clavellatus* and *clavillatus* are not uncommon : *Ms. Sloane 1754*, fol. 234 r°, in the rule above (n. 26), specifies *lexiviam calidam de cineribus clavillatis;* fol. 234 v° contains a rule *Pro lexivia facienda*, which calls for two parts *cineris clavillati* and one part of quicklime, adding, " Et hec valet ad cynopidem. Ad azuram non pones calcem vivam, set cinerem clavillatam." (The addition of quicklime produces caustic potash, KOH, which blackens azurite at once. See Thompson and Hamilton, *op. cit.*, p. 36, n. 47.) Cambridge, University Library, *Ms. Ii.3.17*, fol. 107 r°, requires, for making *Sal alkali*, *cineres clavellatos quantum vis et sextam partem calcis vivi;* and bears a marginal gloss, *Nota. De lexivia facta de cineribus clavellatis.* At the end of fol. 235 r°, *Ms. Sloane 1754* suggests as a substitute for three pounds of *cineris clavellati*, the ash " popularly known as *Wod.*" See also Du Cange, *Glossarium*, *a. v.* " Cinis (2) " : *Cineres clavati, Qui ex fece vini siccata et combusta conficiuntur*, Gall. Cendres de Gravelée : *quos alii vocant* Cineres Clavellatos.

(29) The recipe in the *Segreti* does not contain this reference to vinegar : " Postea eum lava... ut auferatur ab eo viscositas, et postea colabis per pannum lineum; et habebis azurrum valde naturalem." If *aceti* is not a mere scribal error, we must suppose it to have formed part of a lost instruction to wash the blue with vinegar in order to free it of the last traces of soapy lye.

(30) This method of refining azurite is more ingenious than appears from the written description. It is based upon surface-tension phenomena which can be made to effect an almost perfect separation of the grains of azurite from the accompanying impurities. In strong soap solution, the azurite sinks to the bottom, and the lighter material floats. Upon washing with water, the azurite floats, and the heavier impurities remain behind.

[IX]

Nota quod lazurium transmarinum cognoscitur ab alio hoc modo. Accipe de ipso lazurio affinato, vel de minera in pulverem resolutam, et pone aliquantulum de ipso super ferrum ignitum. Si non muta erit suum colorem, ipsum est optimum; si tendet ad nigredinem, parum valet; si ad albedinem, ipsum est factum artificiale, sive artifficialiter (31).

[X]

Et alio modo sic cognoscitur. Pone ipsum in mannubriam vel scutellam, et infunde aquam claram, et frica cum digitis [*fol.* 62 r°]. Postea, aqua subito effusa, sic erunt per rimulas manus tibi, aut renonim, ipsius lazurii valde pulcre reliquie (32).

[XI]

Solent etiam deceptores mineram ponere pravam in fundo saculi et superius ponere bonam (33), quorum fraus et deceptio hoc modo perpendi est, videlicet sustrahendo cum cuspide cutelli aliquantulum de illo quod est in fundo, postea examinando.

[XII]

Sunt etiam deceptores maledicti qui amiscent lazurio arenam subtilem ad augmentandum pondus, quod est p⟨er⟩itium et destructio lazurii. Postea extrahunt cum quodem pastillo, in panno lineo extorquando.

---

(31) This section is substantially identical with § 27 of the *Segreti*, the first paragraph of the second tract in that work, *De multis azurris per artificium fiendis et artificialiter factis; et primo dicendum et videndum est de probatione azurrorum si sunt naturalia di minera an artificialiter facta.* The *Segreti* add: "Si vero affalsatum est, cinis smortua efficitur."

The principle of calcining the sample to blacken copper blues and burn off organic coloring matter is widely extended in modern practice: This *Glühprobe* is one of the most useful preliminary tests of quite a number of pigments. HERACLIUS, *op. cit.*, III, 51, *ed. cit.*, I, 247, *De probatione azurii*, gives equivalent directions. See also LE BÈGUE, *Experimenta*, § 118, *ibid.*, p. 105.

(32) The *Segreti*, § 28, *ed. cit.*, II, 385, give a more plausible version of this rule: *Alio modo cognoscitur per experientiam.* Pone aliquantulu de azurro in manum tua aut pone in scutella, et desuper infunde aquam claram, et frica cum digitis. Postea subito si aderat per manus rimmulas aut per scutellam azurrum, illud valde pulcrum et bonum est; aliter non.

(33) *Ms.* lunam.

[XIII]

Lazurum artificiale hoc modo conficitur (34). Accipe pelli-

(34) White substances converted into blue pigments by staining with indigo and similar materials were not unknown to the ancients (see VITRUVIUS, *De architectura*, VII, 14), and are fairly frequently described in works of the thirteenth century and later. The earliest medieval recipe which I have noted in the following, found in twelfth century Cambridge, St John's College, *Ms.* 79, fol. 147 r°:

Accipe album et pone in fimo calido per diem unam et noctem, et postea extrahe et tere supra aliud marmor valde, et fac subtilissimum pulverem. Et postea habeas spumam que invenitur in caldario ubi tinguntur panni indici coloris, et prohice supra predictum pulverem, et ducas diu. Et cum desiccatum fuerit, iterum spumam appone, usquequo bonum colorem azuri habetur. Postquam bene desiccatum fuerit, pulveriza subtilissime, et cum aqua ablue in bacino, et postea permitte residere, et tunc prohice aquam et proiecta aqua, fac desiccare. Quo desiccato, pulveriza subtilissime supra marmor, et reconde in sacculo. Et nota quod plus valet spuma antequam panni intinguntur. Item, nota quod istud potes facere de cerusa sicut de pulvere marmoris.

This "spuma que invenitur in caldario ubi tinguntur panni indici coloris," like the *flos coloratus* (Ms. *coler-*) of the Caius manuscript, § 12, "qui reperitur in doliis tinctorum in persico" and the *flos* found in the "testis tinctorum in predicto colore" of the present text, may be the foam or "flowers" of indigo or of woad. The latter is perhaps rather more likely. (See THOMPSON and HAMILTON, *op. cit.*, pp. 40, 41, n. 59, and particularly the exhaustive study of the late JAMIESON B. HURRY, *The Woad Plant and its Dye* [Oxford University Press, 1930], unfortunately not referred to in that note.) Thus in fifteenth-century Cambridge, University Library, *Ms. Ii. 3. 17*, fol. 36 v°, a rule of similar purport is found which calls specifically for the *aquavel spuma tinctuer blodi*:

Ad ffaciendum azurum. De azorio faciendo de marmore. Accipe marmor pulverizatum et calcina (*Ms.* calciam) ipsum in igne fimi de bucis, vacce vel bovis, per 2 dies et per 2 noctes, quousque calcinetur. Triatur et inceratur cum aqua vel spuma tincture blodi bis aut ter vel plus; et dimitte siccari, et factum est. Et simili fit eodem modo de calce corti⟨c⟩um ovorum.

This same Cambridge manuscript contains another rule of this sort, at fol. 91 r°, v°, closely related to one in Montpellier, Ecole de Médecine, *Ms.* 277, fol. 84 v°, col. 1, ed. *Catalogue général des manuscrits des bibliothèques publiques des départements*, I (Paris, 1849), 749, 750:

De asur quomodo fiat et quod melius est eo quod de minera extrahitur. Sume marmor valde album et assa ipsum et ingne igni per unum diem et noctem quod preterquam assatum fuerit. Super aliud marmor illud diutissime teras. Deinde sume spumam que est in caldario tinctorum in quo indicus color invenitur, ex qua predicti marmoris pulverem inbibe fortiter, et super predictum marmorem frica; et cum desiccatum fuerit, iterum inhibe, quod tamdiu fac donec azuri colorem habeat. Deinde a lapide remove et reconde, et cum opus fuerit utere.

We cannot guarantee the contents of this cauldron. Like the others, it may have held either indigo or woad.

The white bases used to receive the dyestuff are various: powder of marble, natural and calcined, calcined gypsum, eggshells and white lead are all sanctioned in these rules.

cariam terram (35) in pulverem redactam, aut vitrum calcinatum, aut calcem ovorum, aut calcem marmorum, cum flore reperto in testis tinctorum in predicto colore. Post trossiscas in forma et ad umbram desicca, et hoc cotiens inbibendo predicto flore donec bene colorati sint; quibus utari cum opus fuerit.

[XIV]

Modus alius ad idem valde bonus. Accipe laminas argenteas tenues ⟨quantas⟩ volueris, et eas in lagena suspende super acetum acerrimum in poto (36) vel caldaria erea (37) bene obturata;

(35) *Croceam pellicariam* in the Caius manuscript § 12 is probably a scribal error for *terram* or *cretam p.* (Mrs SINGER and I have verified her reading of the manuscript, and it is unmistakable.) Compare the *terram albam qua utuntur pelliparii* employed in § 75 of the *Segreti*, " Affare bello indico " (*ed. cit.*, II, 415).

(36) *Ms.* parto.

(37) The use of a copper cauldron might be supposed to exercise some influence in the formation of this blue. Recipes for making a blue color from silver plates are extremely numerous in the twelfth century and later. Probably, as GUY LOUMYER says, " La production de la matière colorante dépendait évidemment de la présence d'une certaine quantité de cuivre allié à l'argent." The *Segreti*, 53, " Affare azurro de argento," calls for an alloy of three ounces of silver with one of copper. Against these must be set, for what they are worth, the usual insistence on the purity of the silver, and the warning of the *Liber Magistri Petri de Sancto Audemaro* (ed. M. P. MERRIFIELD, *Original Treatises, cit. supra*, I, 137), that " perfectum azurium erit, et celestini coloris, dum tamen argentum laminarum nullum alligamentum vel mixturam alterius cuiusque metalli in se continuerit, preter quam purissimum et finissimum argentum, quia si in se aliquid eris continuerit, viriditas potius quam celestis vel azurii colorem obtinebis."

Several examples of blues from silver are noted in THOMPSON and HAMILTON, *op. cit. supra*, p. 40, n. 58. The type rule of the *De coloribus et mixtionibus* family there translated is, of course, a defective one, as it calls only for sealing up plates of pure silver in a new pot, and makes no mention of vinegar, urine, or other reagent to be added. It is a striking illustration of the popularity of this recipe that the same omission occurs in transcripts found in at least ten other manuscripts.

In *Ms. Sloane 342*, fol. 132 v°, a rule of similar import but of different phraseology, the silver is again to be sealed up alone. In *Ms. Royal 17.A.III*, fol. 171 r°, a similarly defective rule occurs in conjunction with two others for making blue from silver: one, by the action of vinegar upon silver and lime; the other, by the action of vinegar upon silver alone. Dregs of wine or beer are used to develop a blue color upon silver plates in *Ms. Harley* 3915, fol. 1 v°, and in *Ms. Additional 15549*, fol. 168 v°, *urina puerorum masculorum*. Urine is the active agent in the recipe found in the *Liber Dedali philosophi*, Florence, Biblioteca Riccardiana, *Ms. L. III, 13, 119*, foll. 195 v°-196 r° (ed. J. WOOD BROWN, *An Enquiry into the Life and Legend of Michael Scot* [Edinburgh, 1897], Appendix III, § 14, p. 245), and in a similar recipe in Cambridge, University Library, *Ms. Ii.3.17*, fol. 19 r°. In this Cambridge manuscript,

et superpone equino fimo calido per dies xviii vel amplius; et colligetur ibi flos lazurin valde pulcher.

[XV]

De colore aureo lombardico qui sic conficitur (38). Accipe fel magni piscis, et ipsum rumpe super petram marmorem; et appones aliquantulum terre pellicarie (39), vel vitri calcinati, et aceti boni modicum, terendo in marmore ut fiat ad modum minii (40); de quo scribe in carta quod volueris, et desiccari permitte. Et hoc modo faciunt greci litteras deauratas (41).

[XVI]

Modus alius. Accipe claram ovi gummatam et aliquantulum vitello infectam. Scribe ex eo quid velles, et adhuc (42) madida existente littera, supersperge pulverem cupri, argenti, vel auri, vel eris. Super hec vero lapide cotem confrica et plane cum siccatum est, vel cum dente canino pollies (43).

---

at fol. 118 r°, there is another rule, of exceptional character, which requires that " flores solsequii " be placed " inter laminas argenteas laminatas."

The *De arte illuminandi* alludes to a blue made from silver " as ALBERTUS MAGNUS says." See THOMPSON and HAMILTON, *op. cit.*, p. 5, and n. 58, *cit. supra*. Cambridge, University Library, *Ms. Ee.1.13*, fol. 142 v°, contains a rule " Ffor to make asure as Alberd byddyth." This is not the silver blue of the *Liber III mineralium* of Albertus (ed. A. BORGNET, *Opera Omnia*, V, 78, col. 2), but *açifur*, vermilion, the *azurium* of the *Libellus de alchimia* attributed to ALBERT (*ibid.*, V, 558). See n. 17, above. Cf. also *Ms. Sloane 416*, fol. 114 r.

(38) Mrs MERRIFIELD calls attention to the similarity of this rule to the first chapter of the second metrical book of HERACLIUS, *De coloribus et artibus Romanorum* entitled " De colore auripigmento simili." See her *Original Treatises*, *cit. supra*, I, 198, 199, where the text of JEHAN LE BÈGUE's copy of HERACLIUS is printed and translated.

(39) *Ms. ante* terre *del.* tell. Compare § XIII and n. 35, above.

(40) *Ms.* ad modus. The expression refers, of course, to the consistency of *minium*, loosely employed for actual minium, or for vermilion, or both, tempered for writing : as we should say, " grinding it to the consistency of thin cream."

(41) It is true that Greek texts, and texts based upon Greek traditions, do often prescribe bile as a basis for chrysography without gold. See the useful summary by K. WESSELY in his article, " Chrysographie," *Wiener Studien, Zeitschrift für classische Philologie*, XII (1890), 270 ff.

(42) *Ms. ante* adhuc *del.* h.

(43) In THOMPSON and HAMILTON, *De Arte Illuminandi*, *cit. supra*, pp. 49, 50, a classification of gilding methods is proposed according to which the above process may be summarized under the formula BM.1(3,4)10.1251 : that is, " Gilding in books with gold, silver and base metals in the form of powders

[XVII]

De cerusa conficienda. Accipe plumbeas laminas vel stangneas (44), tenues et aliquantulum perforatas, et ipsas suspende super acerrimum acetum, vel super urinam puerorum bene salsatum, in poto uno bene obturato. Pone sub fimo equino calido et humido per dies xvii vel amplius. Postea ⟨re⟩move et florem abrade. Inveneris album. Et iterum repone ut prius sub fimo.

[XVIII]

Minium colorem sic facies (45). Accipe iam dictam cerusam, et pone in poto ignem habentem subtus, vel melius a latere, quia si non est olla bona, rumpitur; et pone super prunas ardentes, agitando sepe ollam cum spatula ferrea donec tibi color placeat et satis sit rubeus. Quo facto, ab igne removeas, et utares.

[XIX]

Alius modus ad litteras aureas, argenteas, vel cuiusque coloris volueris. Accipe lapidem qui vocatur sparugo, et illud in pulverem in mortario fac contere. Et accipe claram ovi bene temperatam, et cum illa (46) litteras scribe; et adhuc ea medida existente, supersperge illam pulverem; et illa desicca⟨ta⟩ bene, plana et polli cum illo metalo quod vis; et illius colorem retinet, et limaturam (47).

[XX]

Qualiter res deaurari potest, sive sit sigillum, sive nux muscata, gariofilus, vel nummus. Accipe albumen ovorum, et intus

---

whose preparation is not particularized, applied to the purposes of writing, over a sizing which consists primarily of gum and glair, and finally burnished."

A very similar recipe occurs in Cambridge, University Library, *Ms. Ii.3.17*, fol. 154 r°:

De litera cuprea vel enea vel aurea valde pulcra. Tere cuprum in cote duro donec devastetur, et pulverem habeas sufficientem; quem distemperas ovorum glarea gummata ut fiat ad modum vermilionis; de quo scribe quod volueris. Post literam desiccatam, poli dente canino, et erit valde pulcra.

(44) For the manufacture of ceruse, white lead, see THOMPSON and HAMILTON, *op. cit.*, p. 33, n. 39. Tin and lead are not infrequently confused in this and other connections.

(45) *Ibid.*, pp. 33-35, n. 41.

(46) *Ms.* illo.

(47) Gilding method BM.1(2)20.1322. (See n. 43, above.)

dissolve gummi amigdalorum; de quo illinans quidquid voles, post superpone pelliculam auri vel argenti, et leviter cum bombace imprime, et desiccari permitte (48).

[XXI]

Capitulum de stangno indurando et stridorem aufferendo. Primo fundatur in crucibolo cum tertia vel quarta parte plumbi. Postea proice in acetum acrissimum tribus vicibus loto barbaro immediate. Postea iterum superfunde [*fol.* 62 v°] et impone aliquantulum argenti vivi, quasi pars sexta. Proiciatur duabus vicibus in aqua dulci lac virginis vel aliam acutam alibi descriptam, et habebis valde pulchrum quo uti poteris. Plumbum enim clausum intus indurat porros stangni et argenti vivi.

[XXII]

Lazurium (49) vero sic facies. Recipe argenti vivi partes iii, sulphuris, partes ii, et nitri puri pulverizati, partem ɪ. Hec in vase mundo vitreato cum puro et forti aceto commisce; et pista bene exterius, et fac sicut nosti de cinabrio.

Explicit hoc. Incipit Lumen luminum de coloribus (50).

London. DANIEL V. THOMPSON, JR.
12.XI.1933.

---

(48) Compare § 6 of Mrs SINGER's edition of the Caius *Appendix*, and the following excerpt from Cambridge, University Library, *Ms. Ii.3.17*, fol. 154 r°:

Sigillum aureum sive pomuz aut nux muscata hoc modo fit. Accipe glaream ovi gummatam de quo illinies quamcumque deaurandum. Post auri superpone petulam, et leviter cum bombace conprime, et desiccari permitte.

Gilding method M.1(2)30.5442. (See n. 43, above.)

(49) See n. 17, above.

(50) Quatuor sunt colores principales, scilicet niger, albus, citrinus et rubeus...

Gemma Frisius, his method of determining differences of longitude by transporting timepieces (1530), and his treatise on triangulation (1533).

With 4 plates and a facsimile reproduction (no. xvi) of Gemma's Libellus de locorum describendorum ratione, Antwerp, 1533.

ABSTRACT

Comments on and text of: 1. *De novo modo inveniendi longitudinem* (chapter XVIII of *De usu globi*, in GEMMA's *De principiis astronomiae et cosmographiae*, Antwerp, 1530); 2. the first treatise on triangulation, GEMMA's *Libellus de locorum describendorum ratione* (annexed to APIAN's *Cosmographicus liber*, Antwerp, 1533).

I. — INTRODUCTION

Two new methods of fundamental importance—topographical triangulation and the determination of longitudes by transporting timepieces—devised by GEMMA FRISIUS when he was a young man, appear now, after the lapse of four centuries, as the most far-reaching among the various scientific contributions of the founder of the Belgian school fo cartography. *De novo modo inveniendi longitudinem*—chapter XVIII of *De usu globi* (1530)—gives, on half a page, instructions which had to wait two centuries until chronometers became available. The *Libellus* (1) *de locorum describendorum ratione* (1533) has the distinction of offering a clear and essentially complete exposition of the principles of triangulation; it points out the limitations of the methods proposed; it compares favorably with modern elementary treatises on the subject—a rare accomplishment for a pioneering work.

(1) Abbreviation used in the present paper: *Libellus*, not *De locorum describendorum ratione*; the running-head title is: *De regionum et locorum descriptione*; GEMMA referred to the treatise as "libellus De locorum descriptionibus", "libellus de locorum descriptione," etc.

II. — De novo modo inveniendi longitudinem

A. Quetelet (2) considered this method as Gemma's chief claim to fame. F. Van Ortroy, in his model bio-bibliography (3) of Gemma, said that " cet exposé, objet, lui aussi, de diverses reproductions ou traductions, fixe une date très importante "; (4) however, Van Ortroy does not mention the date—he wrote as a bibliographer, not as a historian of science—and his quotation in full (5) of chapter XIX of the 1553 edition of Gemma's *De principiis astronomiae* may give a wrong impression as far as the date and the contents of the original publication of the method are concerned.

Plate 17 shows the title page of the first edition, 1530, of *De principiis astronomiae*. In the second part of this book, *De usu globi*, on D_2 verso and D_3 recto, *De novo modo inveniendi longitudinem* appeared as chapter XVIII; see Plate 19. In the 1553 and later editions, the new method became chapter XIX, and the following lines were added to it, at the end :

" Quam absque horae cognitione variis modis cognosci posse iam antea docuimus. Tum vero horologium exquisitissimum sit oportet, quod aurae mutatione non variet. Quamobrem vtile fuerit in longis profectionibus, potissimum vero nauigationibus, adhibere magnas clepsydras seu horologia aquaria, aut arenaria, quae integrum diem dimetiantur exacte : per quae aliorum horologiorum errata corrigantur."

The " date très importante " is 1530; it marks the beginning of modern navigation; chronometers and sextants have replaced " horologia " and astrolabes, but the method of finding the longitude at sea remains that of Gemma's chapter XVIII.

De principiis astronomiae was printed in October, 1530; the preface is dated September 15 of that year; Gemma was then

(2) Histoire des sciences mathématiques et physiques chez les Belges. Bruxelles, 1864, p. 82.

(3) Bio-bibliographie de Gemma Frisius fondateur de l'école belge de géographie, de son fils Corneille et de ses neveux les Arsenius. *Mémoires de l'Académie Royale de Belgique*, Classe des lettres, collection in-8°, deuxième série, tome XI (418 pages). Présenté le 4 décembre 1911. Bruxelles, décembre 1920.

(4) *Loc. cit.*, p. 66.

(5) *Ibid.*, p. 67.

in his twenty-second year. The decade which witnessed the first circumnavigation of our globe was drawing to a close; the Spaniards were discovering new countries in " uncertain or practically unknown " longitudes (6). Lunar tables were unsatisfactory; eclipses of the Moon were not frequent enough. A new method for determining longitudes, independent from the motions of the Moon, was necessary. Fortunately, the invention of the fusée, about 1525, improved portable timepieces to such an extent that they became capable of a more or less uniform " continuus motus " during 24 hours—even of a " perpetuus motus," if wound up in time. GEMMA realized that it was possible, by means of these improved " horologia," to transport the local time of the point of departure, and to compare it directly with the local time determined anywhere by means of an astrolabe.

The portability and the continuity of motion of the new timepieces are responsible for the genesis of GEMMA's method; the unreliability of the early watches is responsible for GEMMA's later suggestion of the auxiliary use of waterclocks or sandclocks, at least for sea voyages. The bulk of the larger clepsydrae and the discontinuity of motion in the case of small hourglasses made it impossible for the idea of transporting local time to originate before the beginning of the second quarter of the sixteenth century.

III. — APIAN's COSMOGRAPHIA AND GEMMA's DE PRINCIPIIS

A bibliographical digression may be appropriate here—not only as a link between *De novo modo inveniendi longitudinem* and the *Libellus de locorum describendorum ratione*, but also as a means of keeping the next section, devoted to a chapter-by-chapter analysis of the *Libellus*, as free from bibliographical ballast as the case permits.

Plate 18 shows the title page of GEMMA's second edition of APIAN's (7) *Cosmographicus liber*, 1533; GEMMA's treatise on triangulation, the *Libellus de locorum describendorum ratione*,

(6) Cf. Plate 19, end of chapter XVII.

(7) PETRUS APIANUS (BIENEWITZ or BENNEWITZ), 1495-1552. For additional details concerning APIAN's works, see F. VAN ORTROY, Bibliographie de l'œuvre de Pierre Apian, *Le bibliographe moderne*, 5, 89-156, 284-333, 1901.

appeared for the first time as an appendix to this edition. The *Libellus* was annexed to all the later editions and translations of APIAN's *Cosmographia* (8); no separate edition of the *Libellus* is known; the only work by GEMMA—not by APIAN—to which the *Libellus* was ever attached, is the Paris 1547 (1548) edition of *De principiis astronomiae*.

The original edition of APIAN's *Cosmographicus liber* appeared in Landshut, in 1524. GEMMA's first edition of APIAN's work appeared in Antwerp, in 1529, and has the following title: Cosmographicvs Liber Petri Apiani Mathematici, studiose correctus, ac erroribus vindicatus per Gemmam Phrysium; the book was printed by IOANNES GRAPHEUS and published by ROLAND BOLLAERT; the editor's age was then twenty-one. One of the important textbooks of the XVIth century, the *Cosmographia* by APIAN-GEMMA went through more than forty editions and translations until 1609.

Our facsimile of the *Libellus* is made from photostats of the Library of Congress copy (9). There is a variant of the 1533 edition of APIAN-GEMMA: copies sold by GREGORIUS BONTIUS have his mark (10) with the " scutum Basiliense " on Fol. 66 v°, instead of BIRCKMAN's " pingua gallina " (11), and the following line at the bottom of the title page: " Vaeneunt Antuerpiae sub scuto Basiliensi per Gregorium Bontium."

Another variant of the 1533 edition is the so-called 1534 edition of the *Cosmographicus liber*. Although extremely rare, it is represented both in the New York Public Library and in the John Carter Brown Library (Providence, R.I.). It differs from the BONTIUS 1533 edition by an additional I in the colophon, Fol. 66 r°:

Anno. M. D. XXXIIII.
mense Febr.

instead of:

Anno. M. D. XXXIII.
mense Febr.

(8) The title, *Cosmographicus liber*, was changed to *Cosmographia* (or *Cosmographie*) in all the later editions and translations.

(9) By courtesy of Mr. FREDERICK E. BRASCH.

(10) No. 1 of BONTIUS in Marques typographiques, F. VANDER HAEGHEN's *Bibliotheca Belgica*, Ghent, 1893.

(11) No. 7 of BIRKMANN, *ibid.*

Isis, XXII, pl. 16 A. POGO.

GEMMA FRISIUS (1508-1555).
Painter : unknown.
Engraver : JAN VAN STALBURCH.
By courtesy of the Bibliothèque Royale, Brussels.

GEMMA PHRY:

SIVS DE PRINCIPIIS ASTRONOmiæ & Coſmographiæ, Deq; vſu Globi ab eodem editi. Item de Orbis diuiſione, & Inſulis, rebuſq; nuper inuentis.

Veneunt cum Globis Louanii apud Seruatium Zaſſenum, & Antuerpiæ apud Gregorium Bontium ſub ſcuto Baſilienſi.

Isis, XXII, pl. 17 A. Pogo.

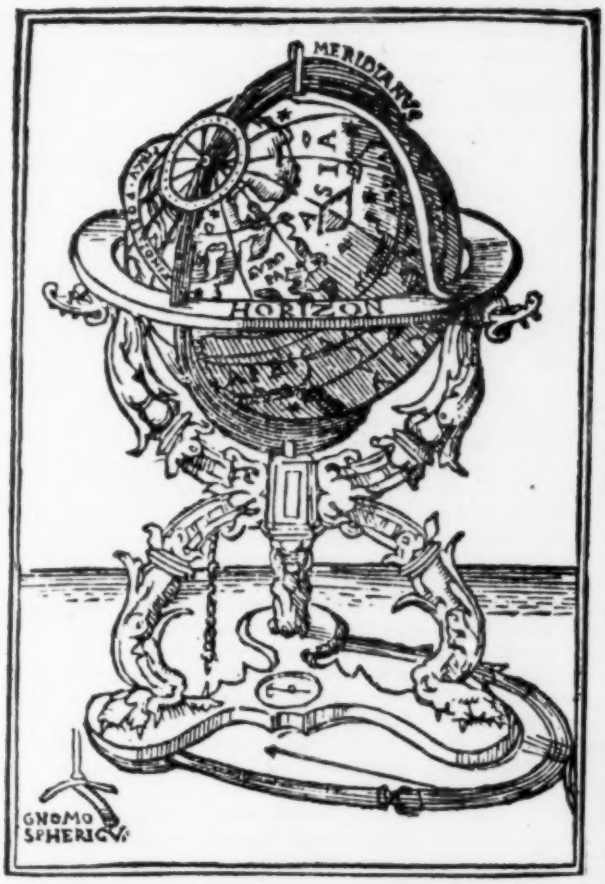
Title page of Gemma's *De principiis astronomiae... Deque usu globi.* (Antwerp, 1530.)

By courtesy of the New York Public Library.

COSMOGRAPHI=

CVS LIBER PETRI APIANI MA-
thematici, iam denuo integritati reſtitutus
per Gemmam Phryſium.

Item eiuſdem Gemmæ Phryſij Libellus de Locorum de-
ſcribendorum ratione, & de eorum diſtantijs in-
ueniendis, nunq̃ ante hac viſus.



Væneunt in pingui Gallina per Arnoldum Birckman.

Isis, XXII, pl. 18 A. POGO.

Title page of GEMMA's 2nd edition of APIAN's *Cosmographicus liber*, with BIRCKMAN's imprint. (Antwerp, 1533.)
By courtesy of the Library of Congress.

Certiſſima ratio per Eclypſes.

ſi longitudinem regionis quæſitam aperient. Certiſſima tamẽ via qua longitudinũ differentiæ inueniuntur ea eſt, quæ per idem aliquod quod in omnibus regionibus eodem momento apparet, vt pote per eclipſes lunæ procedit. Cognitis enim diuerſis horis quibus hæc in diuerſis regionibus contingit, non alia ratione longitudo aut arithmetice aut geometrice, q̃ per præcedentem proxime canonem inuenitur. Verum cum hęc neq; ſemper neq; omnibus appareat, deinde præcedens modus ſic ſatis difficilis ſit, neq; idẽ ſemper promptus propter lunæ coniunctiones, atq; adeo interdũ nonnihil a rei veritate deficiat, propter diuerſitatem aſpectus, & latitudinem lunæ: fit vt longitudines multarum regionum præcipue earum quas nuper Hiſpani adiuere, incertas aut penitus nullas habeamus: neq; enim ex itinerum dimenſionibus ſexuoſis certi quicq̃ colligi poteſt, confirmante id Ptolomeo libro prim. Coſmographiæ. Subnectam igitur aliquid domi noſtræ natũ, quo facili via & quouis tempore longitudines regionum inter proficiſcendum inueniuntur.

Caput. XVIII. De nouo modo inueniẽdi longitudinẽ.

NOſtro ſæculo horologia quædam parua adfabre cõſtructa videmus prodire, quę ob quantitatem exiguam proficiſcẽti minime oneri ſunt: hæc motu continuo ad. 24. horas ſæpe durant, imo ſi iuues, perpetuo quaſi motu mouebũtur. Horũ igitur adiumento hac ratione longitudo inuenitur. Primo curandum vt priuſq̃ itineri intendamus, exactiſſime horas eius loci obſeruet a quo proficiſcimur. Deinde vt inter proficiſcendum nunquam ceſſet. Completo itaque itinere. 15. aut viginti miliarium, ſi quantum longitudine diſtemus a loco diſceſſus libeat addiſcere, Expectandum donec index horologij punctũ alicuius horæ exactiſſime pertingat, eodemq; momẽto per aſtrolabium, aut globũ noſtrum inquirenda eſt hora eius loci in quo iam ſumus: quæ ſi ad minutum conuenerit cum horis quas horoſcopiũ indicat, certum eſt nos ſub eodem adhuc eſſe meridiano, aut ſub eadem longitudine, iterque noſtrum verſus meridiem vel Aquilonem cõſeciſſe. Si vero differat vna hora, aut aliquot minutis, tum hęc reducenda ſunt ad gradus, vel graduum minuta, vt in præcedenti capite docuimus, & ſic longitudo elicienda. Hac arte poſſem longitudinem regionum inuenire, etiam ſi per mille miliaria inſcius eſſem abductus, ignota etiam itineris diſtantia: ſed tum prius latitudo (vt ſemper) eſt addiſcenda.

Caput. XIX. De locorum diſtantijs.

LOcorum intercapedines nullo fere negocio ex globo deprehendimus. Extenſum nãq; circinũ ab vno locorum in alterũ, applicamus deinde æquatori, & quot gradus cõprehẽderit nota

Isis, XXII, pl. 19 A. POGO.

Original text of GEMMA's method of finding longitudes by transporting "horologia," chapter XVIII of *De usu globi*.

End of D2v and beginning of D3r of *De principiis...* (Antwerp, 1530.)

By courtesy of the New York Public Library.

Otherwise, it is absolutely identical with the BONTIUS 1533 edition; the same broken letters in the last signature, Q, exclude the possibility of a " rejuvenation," after the lapse of exactly one year, of the unsold copies of the BONTIUS 1533 edition by an appropriate change in the colophon. It is reasonable to assume that the few surviving copies of the so-called 1534 edition were printed by GRAPHEUS in February, 1533, before the superfluous fourth Roman I was discovered and removed; BONTIUS sold the copies with the misleading colophon along with the more numerous copies bearing the correct date (12). This hypothesis implies, incidentally, that the BONTIUS 1533 copies were printed not only *after* the BONTIUS 1534 copies but also *before* the BIRCKMAN 1533 part of the edition.

The title pages with the globe, reproduced on our Pl. 17 and 18, are of interest to the historian of science as well as to the bibliographer. The legend below the 1530 woodcut, " Vaeneunt cum Globis Louanii apud Seruatium Zassenum, & Antuerpiae apud Gregorium Bontium sub scuto Basiliensi," is one of our sources of information (13) concerning GEMMA's globes of 1530. At the end of the first chapter—*De globi partibus*—of the second part—*De usu globi*—of the companion booklet to GEMMA's globes, we find the following statements: " Profecto talia instrumenta non tam apte describi quam demonstrari ad oculum possunt. In fronte libelli omnia fere depinximus." Attention might be called to the presence, on the woodcut of 1530, of the compass and chain in the tripod supporting " horizontem ligneum," and

(12) F. VAN ORTROY, in his bibliography of APIAN, lists

9 copies of No. 26, BONTIUS 1533,
20 copies of No. 27, BIRCKMAN 1533, and only
1 copy (Genoa) of No. 28, BONTIUS 1534,

as located in European and American libraries; in addition to the Genoa copy of No. 28, he mentions one or two copies in the sales catalogues of TROSS (1879) and of QUARITCH (1881); if the copies of No. 28 in the New York Public Library and in the John Carter Brown Library are identical with the TROSS and QUARITCH copies, the total number of surviving BONTIUS 1534 copies known to me would be 3; otherwise, it could be 4 or 5. The total number of surviving copies of the 1533 edition is at least 33 (I add, to VAN ORTROY's list, the Harvard Library and the N. Y. P. L. copies of No. 26, and the N. Y. P. L. and the Library of Congress copies of No. 27). The BIRCKMAN part of the edition was, apparently, larger than that of BONTIUS.

(13) Cf. VAN ORTROY, Bio-bibliographie de Gemma Frisius, pp. 143-51.

of the " gnomo sphericus," " circulus horarius," and " circulus positionis," in addition to the usual " meridianus mobilis." The title pages of the second (1544) and later editions of *De principiis* show a reduced reproduction of the 1530 woodcut; the title pages of the 1537 and later Antwerp editions of APIAN's *Cosmographia* have (usually dated) woodcuts derived from GEMMA's initialed 1529 modification of the globe adorning the editio princeps, 1524.

I shall close this bibliographical digression with the remark that if the title pages reproduced on Plates 17 and 18 link the 1533 edition of the *Cosmographicus liber* to the 1530 edition of *De principiis*, a more substantial link is formed, by the *Libellus* between the Paris, 1547 (1548) edition of *De principiis*, the only work by GEMMA to which it is attached, and the 1540 edition of APIAN's *Cosmographia*, from which it is derived.

IV. — LIBELLUS DE LOCORUM DESCRIBENDORUM RATIONE

Our facsimile reproduces, in full, the original *Libellus*, as it appeared in the 1533 edition. The 1540 and later editions of the *Libellus* show—in addition to occasional changes in wording or spelling, and to numerous discrepancies in capitalization, abbreviations, punctuation, etc.—considerable and essential modifications which are indicated in the footnotes (14) to the following chapter-by-chapter analysis of the treatise.

TITLE AND PREFACE. The expression, " nunquam ante hac visus"—fully justified in the 1533 edition—reappears in the title of the *Libellus* of later editions. The dedicatory letter, addressed to THOMAS BOMBELLI (15) and dated Antwerp, January 31, 1533, is reprinted in later editions in the same place of the book, i.e., between the title of the *Libellus* and the title of its first chapter. A more appropriate place for it would be at the beginning of the volume : it is GEMMA's preface to his second edition of APIAN's *Cosmographicus liber*. The young editor is fully aware of the fact that " si uetus exemplar (i.e., APIAN's editio princeps, 1524)

(14) The quotations in these footnotes follow the wording and spelling of the 1540 edition.

(15) Biographical data concerning Thomas Bombelli are not available to me. Who was this worthy ?

cum nostro (i.e., GEMMA's 1529 edition) conferatur," his share in the success would be comparable to that of the author. GEMMA's reflections on the contemporary " copyright " situation are worth reading.

CHAPTER I (16). Topographical survey—with unknown longitudes, latitudes, and distances of the stations—was a novelty. The horizontal use of the astrolabe for pointings on terrestrial objects was an idea as simple and far-reaching as GEMMA's suggestion of transporting local time for determining differences of longitude. The horizontal use of an astrolabe for the determination of azimuts of celestial bodies was centuries old; GEMMA was the first to realize that by determining the bearings of terrestrial landmarks, and by repeating the observations at several stations, a network could be drawn on paper which would give, by the intersections of corresponding pointings, a map of the country surveyed. The instrument devised by GEMMA for this graphic triangulation is a link between the astrolabe and our plane table; its Latin name, " instrumentum planimetrum," was hellenized in the 1540 and later editions, and became " instrumentum epipedometrum "; the insertion of a compass in an astrolabe was then in vogue—GEMMA's nephews, of the ARSENIUS family, helped to popularize such instruments.

The choice of the Antwerp Cathedral as the first station was highly appropriate; so was the choice of Louvain, in the illustration of the " angulus positionis " counted from the (magnetic) meridian of Antwerp. The value of the clear and methodical exposition is enhanced by such devices as the inclusion of stations (Middelburg and Bergen op Zoom) invisible from Brussels, the consideration of the case of the alignment of three stations, and the determination of the scale without measuring the base line Antwerp-Brussels. GEMMA points out that the illustration on Fol. 59 v° is not a map : " Neque volo quod quisquam putet me hic veras lineas positionum assignare, sed tantum pro declaratione comminisci."

(16) In the 1540 and later editions, " instrumentum planimetrum " was changed to " instrumentum epipedometrum "; the misprint, " Gandauum tendere ab arctis 40 gradibus quasi in occidens " (Fol. 59 r) was corrected to " ... 80 gradibus...", to conform to GEMMA's network (the magnetic bearing of Ghent, referred to GEMMA's " Linea Meridiana Antuerpiae," is about 90°).

CHAPTER II (17). The elementary geometrical problem of plotting the positions of stations whose mutual distances—not directions—are known, is discussed here as a counterpart to the previous problem of mapping stations determined by their bearings only. GEMMA is aware of the fact that the solution of the problem will meet with surveying difficulties, if the mutual distances of the stations are to be measured " in oceano & inter montes."

The author considered, apparently, chapter II as a " second method " of making maps, and the two or three following chapters merely as special cases of surveying practice; in the original 1533 edition of the *Libellus*, the " third method " was clearly defined by the title of chapter VI, " Tertius modus per distantiam & angulum positionis "; this clear structure of the *Libellus* was somewhat obscured in the 1540 and later editions, when chapter V became a " third method," and chapter VI, " quartus modus."

CHAPTER III (18). GEMMA gives here a solution of the surveying problem of determining—by means of similar triangles—the distance of an inaccessible object. The unknown distance *ad* is derived from the measured distances *bc*, *bd*, and *de* by the formula

$$ad = \frac{de.bd}{de - bc}.$$

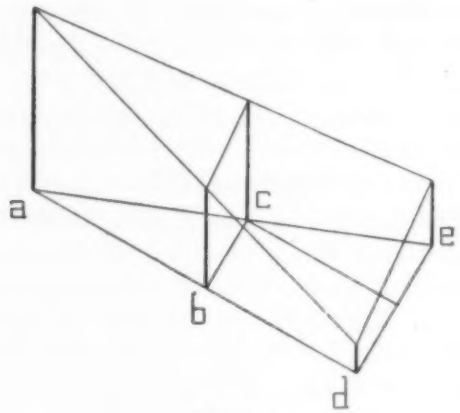


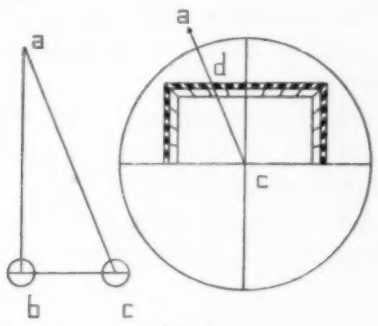
FIG. 1.
Distance by similar triangles (four stations).

(17) Added, in the 1540 and later editions, at the end of chapter II : " Sed vide capitis sequentis precepta."

(18) In the 1540 and later editions, the title of chapter III was changed to : " De invenienda vera distantia " etc.

GEMMA informs the reader who should desire a mathematical proof that he has it in readiness for him. The angles *abc* and *ade* must be equal; GEMMA's choice of right angles was, apparently, due to his desire to simplify the surveying routine.

CHAPTER IV (19). The use, for surveying purposes, of the altimetric or shadow scales, in the lower quadrants on the reverse side of an astrolabe suspended by its ring, was not new (20). GEMMA introduces here the new idea of using the *altimetric* scales in a *horizontal* plane for determining the distance of a remote object.



$$ab = \frac{12 \times bc}{d}$$

FIG. 2.
GEMMA's horizontal use of the altimetric scales (two stations).

The possibility of a similar horizontal use of the cross-staff did not occur to GEMMA at the time of the writing of the *Libellus*. In chapter XIV—*De regionum descriptione par radium*—of his *De radio astronomico & geometrico liber* (1545), he states, on Fol. 24 r°: " Nolo hic esse prolixior, eo quod hanc rationem docuerim in libello De locorum descriptionibus. Verum id temporis non venerat in mentem radii in hac re facillimus vsus."

The horizontal use of PEURBACH's " gnomo geometricus " (21)

(19) In the 1540 and later editions, " scala altimetra " was changed to " scala hypsometra." On the other hand, the Greek influence (*διάμετρος* is feminine) visible in " alteram diametrum transuersam " and in " duabus diametris," disappeared in the later editions.

(20) See, e. g., STOEFFLER's *Elucidatio fabricae ususque astrolabii*, Oppenheim, 1513 (colophon : 1512).

(21) A rectangular frame *ABCD*, for vertical use (plumbline attached), with an alidade-ruler *AE* rotating about the upper corner *A*; both the lower horizontal side *BC* (" latus rectum ") and the vertical side *DC* (" latus versum ") are subdivided into 1200 parts. Cf. my FIG. 3.

was described in his *Quadratum geometricum;* although the booklet was available in printed form since 1516, it remained unknown to GEMMA; more information on this subject will be found in the section devoted to JUAN DE ROJAS SARMIENTO's *Commentarii.*

CHAPTER V (22). The relative positions and distances of the inaccessible points, *a*, *b*, and *c* are determined by means of their bearings from the stations *d* and *e* at the ends of the measured base line *de*. In the 1540 and later editions this became the "third method," and additions in the chapter title, in the text, and especially at the end of the chapter pointed out that no compass or previous determination of the meridians of the stations *d* and *e* was required: the base line could be used for the orientation of the instrumentum epipedometrum.

CHAPTER VI (23). The method of triangulation by distances and bearings—the "third method" in the *Libellus* of 1533, or the "fourth method" in the 1540 and later editions—is an application and combination of the precepts given in the previous chapters. This chapter received so little attention in the revised

(22) Additions and changes in the 1540 and following editions:

Added, to the title of chapter V: "Et qua ratione longe facillime regio describi possit ex ipsis absque nautico Compasso, aut liniae meridianae obseruatione."

Changed, Fol. 62 v° 15: "vnum locorum dimentiendorum" to "aliquem locorum dimetiendorum".

Added, Fol. 62 v° 18: (after "nota") "hoc est, quotum gradum instrumenti index demonstret, dum ad singula loca dirigitur."

Added, Fol. 63 r° 21: (after "vergat ad *c*,") "nulla scilicet habita coeli aut plagarum ratione."

Added, at the end of chapter V: "Atque hoc est tertius modus describendi regiones longe omnium facillimus, quia tantum opus est circulo diuiso in .360. partes cum indice. Neque alicuius alterius rei, nempe Compassus, Meridiei, Latitudinis Longitudinis aut distantiae regionum vsus aut opera requiritur. Praeterea adeo certus est, vt in regione .50. aut .60. aut .100. etiam miliarium Germanicorum nullam quisquam percepturus sit erroris notam. Obseruandum autem, vt singula regionis loca bis in conspectum veniant, semperque dum alio te confers, instrumenti diameter ad locum dirigatur quem antea perlustrasti, aut quem velis mox accedere. Sicque singulas vrbes, vicos, pagos, turres, domos, aliaque inscribere (si libet) poteris. Quemadmodum nos in precedenti figura depinximus ob oculos."

(23) In the 1540 and later editions, "Tertius modus" was changed, in the title, to "Quartus modus"; added, at the end of chapter VI: "Quod vero [de] Meridiani obseruatione dixi, potest ex capite precedenti facilius fieri, absque Compassus aut Meridiei obseruatione."

editions that the discrepancy (24) between the text and the accompanying figure remained unnoticed.

CHAPTER VII (25).Approximate solution of the following problem : knowing the difference of latitude of two places, and their distance, to find their difference in longitude. The text of this chapter was considerably changed in the 1540 and later editions of the *Libellus*. No great precision could be expected from the solution offered : the two places had to be sufficiently close to justify the fiction of a plane rectangular triangle, and this implied a rather unreliable value of the difference of latitude. This chapter is closer related to the *Cosmographicus liber* than to the *Libellus*.

V. — JUAN DE ROJAS SARMIENTO'S COMMENTARII

Book V—*De describendis provinciis*—of JUAN DE ROJAS SARMIENTO's (26) *Commentarii in astrolabium* (Paris, 1550) consists

(24) To make the text correspond to the figure, the distances *ab* and *ac* should become 4 and 3, respectively, thus destroying the progression, 3, 4, 5, 6, 7; the bearings of *e* should be changed to " declinans ab ortu in austrum."

(25) Additions and changes in the 1540 and later editions :

The beginning of chapter VII was changed to : " Qvoniam latitudinum inuentio facillima est, longitudinum vero difficillima, placuit hunc modum pro Cosmographiae studiosis ad calcem libri subiungere. Subducta ergo latitudine vnius loci ex latitudine alterius, residuum vocatur differentia latitudinis. Hanc duc in .15. miliaria Germanica, ad quae etiam debes reducere distantiam veram locorum, dando singulis miliaribus .4000. passuum. Veram igitur distantiam sic acceptam, multiplica in se quadrate : Similiter miliaria quae ex differentia latitudinis prouenerant : Quadratum hoc differentiae latitudinis aufer ex quadrato verae distantiae, restabit quadratum miliarium respondentium differentiae longitudinis quaesitae. Quaere ergo radicem quadratam illius residui, habebis miliaria, quae si diuidas per numerum miliarium respondentium vni gradui longitudinis in latitudine media, prodibit longitudinis differentia quaesita. Numerum vero miliarium respondentium vni gradui longitudinis in latitudine media, disces ex 13 capite primae partis Apiani, exemplo secundo, vbi de longitudine differentibus locis agitur."

Exemplum of chapter VII. The latitude of Ghent is changed from 51° 30′ to 51°24′; the difference of latitude between Ghent and Louvain becomes 26′ instead of 32′; the computed difference of longitude becomes " about " 1°20′ instead of the previously found difference of 35′.

Added, Fol. 65 v° 32 : (after " de alijs minutis ") " Quae vero hic ex tabulis sinuum adduci possent, consulto praetermitto, quod ad institutam Cosmographiae methodum non videantur pertinere, sed altioris esse considerationis."

Added, Fol. 66 r° 11 : (after " perfecti & imperfecti ") " aut finiti & infiniti."

(26) Illustris uiri D. Ioannis de Roias Commentariorum in Astrolabium quod

of an annotated reprint of the first six chapters of GEMMA's *Libellus;* it is based on the Antwerp 1540 edition of APIAN's *Cosmographia*, and the chapter-by-chapter commentary to the *Libellus* is illustrated by three additional figures. The illustrated annotations by DE ROJAS cover more than five pages; there is no need of reproducing them here, in full, because their chief purpose was the weaving of GEMMA's chapters into the fabric of DE ROJAS SARMIENTO's six books on the planisphere. However, the end of DE ROJAS SARMIENTO's preface to his book V, and his comments on GEMMA's chapter IV are quoted below, because they offer samples of contemporary criticism of the first treatise on triangulation.

The *Praefatio* to book V is addressed to CHARLES V, points out the importance of surveying, and ends (27) with the following appreciation of GEMMA's work :

" Sed ut ad rem ueniamus. Cum haec describendarum prouinciarum ratio a Georgio Peurbachio ante nos, nuperrimeque a Gemma Frisio tradita iam sit, nec noua nunc dimetiendarum prouinciarum genera uelim inuenire, nec aliena pro meis praedicanda esse uiderentur, illud praesertim Quintiliani in mentem reuocans, inuento quod optimum est, qui aliud quaerit, peius inuenit, id ipsum ex Gemmae libello de prouinciarum descriptione, exque ipsius uerbis interpretis tantum hac in parte usus officio docere decreui. Cum re uera nullus alius diligentiore cura rem executus sit. Quare eum ipsum nunc loquentem audiamus."

This quotation proves that DE ROJAS did not grasp the essential difference between the rules of surveying practice collected by GEMMA's predecessors and the treatise on triangulation written by DE ROJAS SARMIENTO's former teacher. The reference to PEURBACH has little to do with the " describendarum prouinciarum ratio "; DE ROJAS is more explicit on this point in his comments (28) to GEMMA's chapter IV :

" Haec dimetiendi ratio e Georgij Peurbachij libello de Quadrato geometrico, propositione secunda ad uerbum fere desumpta est. Quae tamen ad scalam

Planisphaerium uocant, libri sex nunc primum in lucem editi. Paris, 1550 and 1551. The *Catalogue of printed books* of the British Museum claims that the 1551 edition is " a duplicate... with a new titlepage " of the 1550 edition; this statement may be correct for the 1551 copy in the British Museum; the copies accessible to me (N. Y. P. L. and Harvard Library) show that the two editions differ slightly in pagination, and that the otherwise unchanged text of 1551 has misprints of its own. My quotations refer to the 1550 edition.

(27) ROJAS, p. 202.

(28) ROJAS, p. 217.

nostrae sphaerae geometricam facile transferetur, modo singulas eius lateris partes (quas 12. esse diximus) non in 60. sed in 100. partes (29) diuiserimus. Sic enim quodlibet eius latus in 1200. partibus, ut Quadratus a Gemma (30) propositus, manifeste constabit. Vnum tamen illud admonendum nobis est (quod & Peurbachius admonuit) cum distantiam quam dimetiri uelimus, scalae latus in se saepius continebit; in multam posse errare distantiam..."

The remainder of this note is a paraphrase of the second half of PEURBACH's *Propositio secunda*—" ad uerbum fere desumpta "—rather than a commentary on GEMMA's chapter IV. GEMMA resented DE ROJAS SARMIENTO's assertion; in his *De astrolabo catholico liber* (1556), R5v°, GEMMA makes the following statement :

" Per hos angulos docuimus describere regionem quamlibet, in libello de locorum descriptione quem primo Cosmographiae Apiani adiunximus, quem repetit Ioan. Royas in altero planisphaerio, quanquam non recte mea ex Purbachio desumpta esse asserat, id quod facta collatione quilibet facile intelliget. Nam ego ne tum quidem Purbachij de quadrato Geometrico scripta videram, et nunc examinatione facta video longe diuerso a me traditam rationem dimetiendi loca multum distantia atque ab illo traditum est. Alioqui quid vetat eadem ab aliis atque aliis tradi?"

In order to prove that DE ROJAS SARMIENTO's criticism of his former teacher was not justified, I reproduce here PEURBACH's exposition of the horizontal use of the " gnomo geometricus " (31) :

" PROPOSITIO SECVNDA.

Distantiam inter te & signum a longe positum, hoc instrumento discernere.

Pone instrumentum facialiter super plano, & dirige lineam BC, secundum uisum, ita ut sit linea recta ab oculo ad signum a longe positum, et firmato sic instrumento, dirige uisum per ambo pinnularum foramina, uoluendo regulam AE, donec per foramina uideas signum idem a longe positum, et considera, ubi regula AE, secat latus DC, et ibi sit punctus N. Nam ND ad DA sicut AB ad BP, distantiam quaesitam. Ideo quia unumquodque laterum est 1200, tunc 1200 diuide per partes in DN contentas, et numerus, qui exibit, ostendit distantiam quaesitam. Totiens enim latus AB, continetur in distantia quae quaeritur, ut si uelim reperire distantiam BP, ordinabo instrumentum sic, ut linea instrumenti BC, sit directe in una linea cum distantia BP, et dirigendo uisum per pinnulas, abscindat regula latus DC, in 29 partibus primi centenarij. Diuido 1200 per 29,

(29) The 1551 edition has here one of its " independent " misprints : " in 110. partes."

(30) ROJAS seems to confuse here GEMMA's example (the " scala geometrica " has the usual 12 divisions ; the distance, ab = 1200 feet, has nothing to do with the scale) with PEURBACH's method (the side of the " quadratum geometricum " is divided into 1200 parts).

(31) I quote from the Libellus M. Georgij Purbachij de Quadrato Geometrico incorporated into REGIOMONTAN's Scripta... de Torqueto, Astrolabio armillari..., Nuremberg, 1544 (Fol. 68 r° to 69 r°; the pagination is confused in this part of the book).

exeunt 41 et 9/11, dico ergo quod distantia BP, habet lineam BC, instrumenti mei quadragesies et semel in se, et cum hoc nouem undecimas unius. Sic fac in reliquis. Ordinaui tamen hic unam tabulam, quam intrabis cum partibus, quas abscindit regula AE, de latere DC, et inuenies quotiens BC, contineatur in distantia quam quaeris. Et facta est diuidendo 1200 per numerum partium cum quo intratur in tabulam, et numerus quotiens scriptus est indirecto. Ex qua id intelligere potes, cum distantia quam metiri uoles, continebit in se instrumenti magnitudinem seu lineam BC, saepius, facilis potest error incidere in multis cubitis, ut si distantia est sexcenties maior, quam linea BC, facile potes errare in ducentis, tantis quantitatibus, quanta est BC. Nam si AE abscindit de latere DC duas partes, erit distantia 600. Si abscindit tres partes, erit 400, una uero pars in instrumento est ualde parua, et tamen inter distantias differentia, quae illi parti correspondet, est longitudo instrumenti ducenties sumpta. Quanto igitur portio DN minor est, tanto error maior facilior que. Id quidem accidit non propter instrumenti defectum, sed paruitatem eius, & uisus fallaciam, qui uix ad tantam distantiam praecisus esse potest ad recte dirigendum latus BC, & regulam AE. Siue pinnulae sibipsis uicinae sint, siue distantes. Quicquid tamen infra centum cubitos distat, id satis praecise dimetiri poterit.

SEQVITVR TABVLA."

A comparison of this quotation with the text of chapter IV of the *Libellus* shows that a borrowing " at uerbum fere " is out of the question. There is an essential difference between the two methods : PEURBACH determines the distance directly, without leaving the station, using the length of the side of his " gnomo geometricus " as the known side of the rectangular triangle ABP; GEMMA, on the other hand, introduces an auxiliary station " ad certam aliquam distantiam, quae quanto maior fuerit, tanto certior erit operatio." PEURBACH tried, implicitly, to avoid the use of rapidly varying tangents of small angles by limiting the distance at which his " gnomo geometricus " could be safely applied;

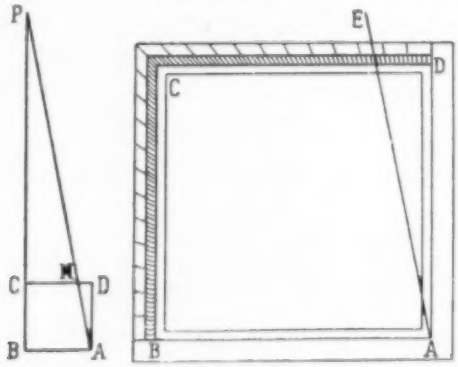


FIG. 3.

PEURBACH's horizontal use of the " gnomo geometricus " (one station).

GEMMA, on the other hand, suggested to choose a base comparable with the distance—the tangent varies slowly when the angle approaches 45°.

GEMMA's horizontal use of the altimetric scales on the back of an astrolabe may, therefore, be considered as independent from PEURBACH's horizontal use of the "gnomo geometricus." Both PEURBACH and GEMMA made, by these methods, merely incidental contributions to the solution of a single surveying problem. The importance of GEMMA's *Libellus* is due, of course, to its far-reaching chapter I, not to its chapter IV. Thus, in spite of DE ROJAS SARMIENTO's criticism, GEMMA's *Libellus* remains a monument to the originality of its author—and, as the first treatise on triangulation, an important landmark in the history of cartography.

Long quotations from and short comments on GEMMA's *Libellus* have appeared in various books and papers published between the time of DE ROJAS SARMIENTO and the time of VAN ORTROY. I shall mention the names of but two authors of recent papers on the subject : HENRI BOSMANS, S.J. (32), and E.G.R. TAYLOR (33).

VI. — LIFE AND WORKS OF GEMMA FRISIUS

REINERUS GEMMA FRISIUS was born in Dokkum (Friesland), on December 8, 1508; he died in Louvain, on May 25, 1555. Educated in Groningen (before 1525?) and in Louvain (master of arts, 1528; doctor of medicine, 1541), GEMMA became a practicing physician and (after 1537?) professor of medicine at the University of Louvain. GEMMA's lectures on mathematics (after 1543?) were, apparently, private; he was the teacher of GERHARD MERCATOR and of JUAN DE ROJAS SARMIENTO.

As a writer on mathematical and cosmographical subjects, as a globemaker, cartographer, and designer of astronomical instruments (in collaboration with his nephews of the ARSENIUS family), GEMMA occupies an important place in the history of sixteenth-

(32) Communication sur un exemplaire du Cosmographicus Liber de Pierre Apian, édition d'Anvers, 1533. *Annales de la Société scientifique de Bruxelles*, 41, 203-06, 1922.

(33) The earliest account of triangulation. *The Scottish Geographical Magazine*, 43, 341-45, 1927.

century science. His original contributions were few but far-reaching.

For additional information concerning GEMMA and his globes, maps, instruments, correspondence, portraits, lost manuscripts, etc., I must refer the reader to VAN ORTROY's monumental bio-bibliography of the " fondateur de l'école belge de géographie." The following list, arranged in chronological order, gives the published works written or edited by GEMMA.

(A) Cosmographicus liber Petri Apiani. Antwerp, 1529.
(B) De principiis... (See Pl. 17.) Antwerp, 1530.
(C) Libellus... (See Pl. 18 and facsimile.) Antwerp, 1533.
(D) Usus annuli astronomici. Preface dated 1534; published before 1537; earliest surviving complete text in the Antwerp, 1539 edition of (A).
(E) Arithmeticae practicae methodus facilis. Antwerp, 1540.
(F) De radio astronomico & geometrico liber. Antwerp, 1545.
(G) De astrolabo catholico liber. Edited by CORNELIUS GEMMA. Antwerp, 1556.

Items 7 to 130 of VAN ORTROY's bibliography of GEMMA give full details concerning the various editions, translations, revisions, etc. of our items (A) to (G). The popularity of (E) lasted for generations : there were about 75 editions, including translations into French and Italian, between 1540 and 1661, published in a dozen places; the great success of (A) has been mentioned before; (B) went through a dozen Latin and French editions between 1530 and 1582; (F) was translated, late in the XVIth century, both into French and Italian.

The portrait of GEMMA—Plate 16—is a reproduction of the copper engraving by JAN VAN STALBURCH (34), for which I am indebted to Mr. L. GUINET and the Cabinet des Estampes of the Bibliothèque Royale in Brussels. The engraving is dated, Louvain, 1557; it offers, incidentally, the earliest dated reproduction of an astrolabe obviously made by WALTER ARSENIUS; the earliest astrolabe bearing his signature is dated 1558—see GUNTHER (35),

(34) According to F. VAN ORTROY's article on STALBURCH in the *Biographie Nationale de Belgique*, 23, 550-51, 1923-24, the engraver flourished in Louvain, in the middle of the XVIth century. Another copy of his portrait of GEMMA is in the Prentenkabinet in Amsterdam.

(35) R. T. GUNTHER. The Astrolabes of the World, Oxford, 1932. Reviewed in *Isis*, XX, 310-16, 492-95, 1933-34.

No. 226, Pl. 95; the design of the rete of our astrolabe is very similar to the one in King's College in Cambridge—see GUNTHER, No. 235, Pl. 98,—to which the rather early date, 1540, has been assigned.

To GEMMA's iconography might be added, tentatively, the woodcut of a man holding the annulus astronomicus, adorning the title page, i.e., fol. 54 r°, of the Antwerp, 1539 edition of our item (D); GEMMA's portrait reproduced by VAN ORTROY appears to differ less from this woodcut than from GEMMA's likeness engraved by STALBURCH.

Harvard Library, 189. A. POGO.

LIBELLVS DE LO
CORVM DESCRIBENDORVM
ratione, & de eorum diſtantiis inueniendis nunquam ante hac viſus.

Per Gemmam Phryſium.

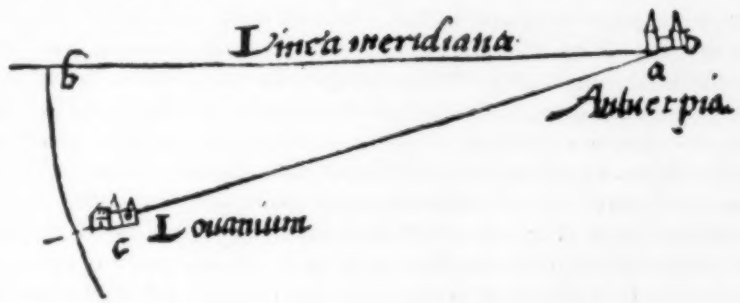
MAGNIFICO VIRO D. THOMÆ BOMBELLI
Gemma Phryſius. S. D. P.

NOn adeo nuper eſt magnifice uir quòd ſemel hunc librum amicorum impulſibus emendatum ſic ſatis pro eo tempore ſtudioſis reddiderim. Qua ſane in re neq; oleum neq; operam mihi perdidiſſe uideor, nam præter omnia exẽplaria quæ id temporis excuſa ſunt, tam paſſim alia deſiderantur, Quamquam laudem hanc non equidem iure mihi uendicare poſſim, ſed potius autorem ſpectet ſuum. At non nihil etiam nobis cedet, ſi uetus exemplar cum noſtro conferatur, adde etiam niſi noſtro impulſu factum fuiſſet, nunq; in tam multorum manus peruenniſſet. Iam uero uti ſtudioſorum ſedulitati non deſim, deſideratum a nonnullis librum, elimatis quæ tunc per oſcitantiam (ut fit nonnunq;) mendis, pœnitus terſum, & ex omni parte ſuis conſtantem partibus affero, & quo gratior, immo utilior ſit, adieci nonnulla quæ ut in hoc opere ad perfectionem artis deſiderari poſſent, ita etiam a nemine antea (quod ſciam equidem) eo modo ad lucem perducta ſunt. Quum autem ita hodie ſint mores, ſi quis quid facit in arte aliqua, hoc ſine patrono in publicum non prodeat, Nulla honeſta excuſatione prætermittere poſſum, quin hoc noſtrum quantulumcũq; laboris tibi tuæq; protectioni commendem, & ſi ſcio te (ut es gloriæ minime auidus) ægre laturum, ſi quis quocunq; modo nomen tuum ſatis præter hoc clarum laudibus efferre uelit. Vincit enim me cũ in omnes, tum uero maxime in doctos tua humanitas, qua ſemper neq; moleſtijs neq; impenſis parcens eos promoues et tanquã Mœcenas alis & foues. Gratus igitur ſit hic noſter exiguus conatus quem poſt (ſi Dijs fauent) maiora ſequentur. Vale. Antuerpiæ pridie kalendarum Februarij. Anno D. 1533.

DE DESCRIPTIONE REGIONIS ALICVIVS IN PLAno incognitis latitudine, longitudine, & diſtantia.

CAPVT PRIMVM.

NEgare profecto non poſſum, quin omnium modorum certiſſimus in hac re ſit is qui per longitudines ac latitudines locorum incedit, poſtea autem is qui per latitudines & angulos poſitionis regiones deſcribit: Vltimo vero loco qui per ſolos poſitionis angulos agit. Quem modum hic primũ ponimus, eo q̃ alijs facilior ſit & vulgarior. At non inepte explicandũ mihi videtur, quos hoc in loco angulos poſitionis appellemus. Angulus igitur poſitionis hic vocatur interſtitium horizontis alicuius loci inter meridianum eiuſdem & circulum verticalem ab hoc loco per aliũ procedentem. Aut vt facilius intelligas diſtantia quæ eſt inter meridianum alicuius loci & lineam hinc per alium locum tranſeuntem, vt patet in ſequenti figura, vbi, a, b, eſt linea meridiana, a, c, linea poſitionis vnius loci ab alio, b, c. hic non adeo proprie (fateor) angulum poſitionis vocamus, ſed quum hic tantum requiratur capiamus baſim, b, c, pro toto angulo, a, b, c.



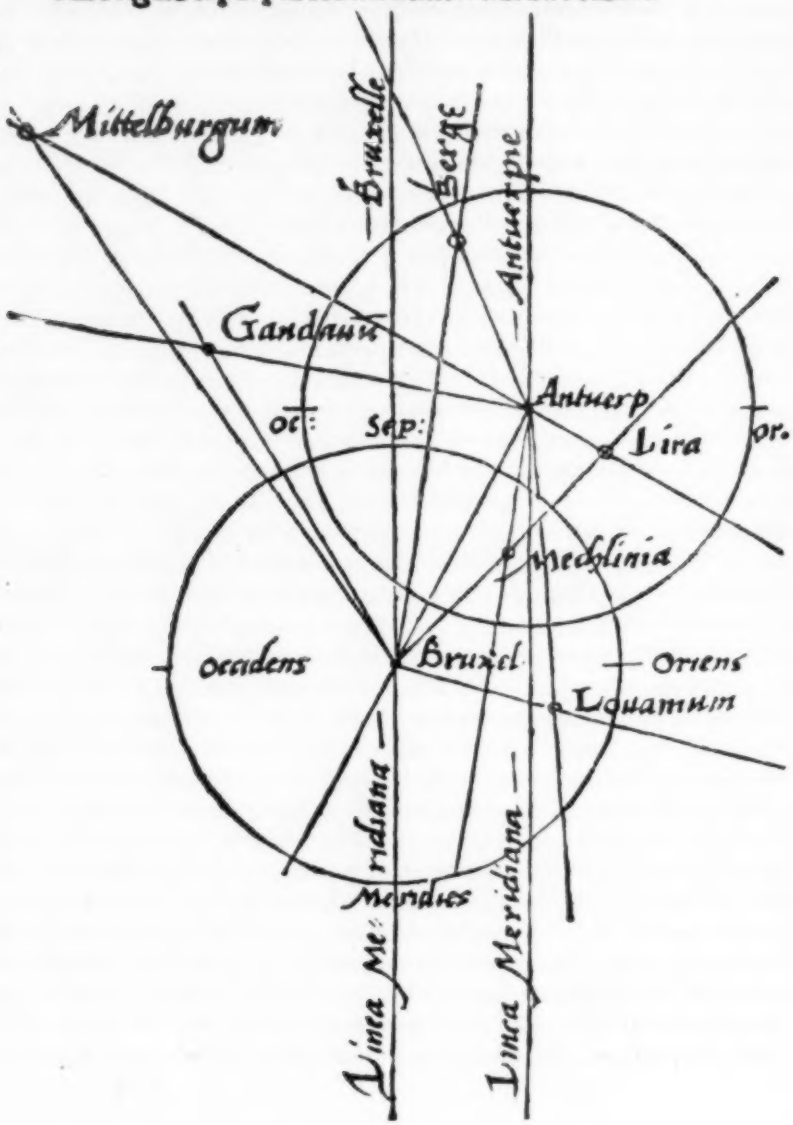
DE REGIONVM ET LOCO.

COgnita finitione nominis si per hunc modum prouinciam aliquã vel etiam totum regnum cum omnibus oppidis describere voluerís, primum in assere plano construe instrumentum tale, fiat circulus, qui in quatuor quadrantes dissecetur, quadrante quolibet rursus diuiso (vt solet) in. 90. gradus, postea affigatur per centrum index cũ perspicillis aut pinnulis quemadmodum in dorso astrolabij. Hoc instrumento facto opus erit etiam instrumento nautico (quod Compassum appellamus) nam ab illo fere tota res pendet, quibus habitis ita procedito. Pone instrumentum planimetrum primum in plano, & super ipso Cõpassum, ita vt latus Cõpassi quadrãgularis adiaceat lineæ meridianæ instrumenti inferioris. Deinde verte instrumẽtum cum cõpasso eo vsq; quo index compassi correspondeat sibi subscripto indici, & post hæc instrumento ita manente compassum tanq; perfunctum suo officio remoue. Si nunc angulum positionis alterius loci a tuo scire velis, manẽte instrumento immoto, voluc indicem donec per perspicilla eius videas locum alium, videbis mox angulum positionis a meridie vel Septentrione secundum ipsius indicis remotionem ab eis. Sed quorsum hæc? roget aliquis, etiam si habeam ab vno loco positiones vel situs omniũ locorum si non adsit distantia nota nihil profuerit. Verũ dicis ab vno loco, nam nisi a duobus locis habeas angulos positionum non poteris describere tertium. Igitur si nunc prouinciam totã depingere placet, Inuestiga primum ab vno oppido, a quo placet incipere, omnium circumcentium locorum situs: eosq; trahe in plano descripto primum circulo ex vno puncto posito ad libitum, eoq; diuiso in 360 gradus vt est ipsum instrumentum planimetrum, & cuiq; lineę positionis adsigna suum nomen. Vt autem cuites multam peregrinationem, ascẽde turrim oppidi altissimam, atq; inde quasi e specula circumspice. Post hæc proficiscere ad aliud oppidum, atq; ibi similiter agito cum angulis positionum omnium circumiacentium locorum, quos vbi habueris, pone punctum illius oppidi a priori puncto in quacunq; velis distantia, super tamen sua linea positionis, atq; ex hoc puncto trahe circulũ obscurum, & meridianum distãtem a priori meridiano vndiq; æqualiter. Demum trahe ex hoc puncto lineas positionum locorum iam inuentas, & vbi tunc fit intersectio lineę alicuius cum prioribus eiusdem loci, ibi notula ponenda est pro tali loco. Haud dissimili ratione ages cum omnibus locis alienius regni, profecturus eo vsq; donec omnia quæ describere decreueris, bis in tuum conspectum venerint, atq; omnium duas lineas

habeas poſitionum. Exempli cauſa, deſcribamus aliquot loca Brabantiæ, atq; id quo facilius fiat aſcendendo turrim Antuerpiæ cum inſtrumentis, pono inſtrumentum ſecundum plagas mundi, & video circumquaq; quæ cunq; poſſum loca. Reperio autem Gandauum tendere ab arctis 40 gradibus quaſi in occidens, Liram ab ortu 30 gradibus in auſtrum declinare, Machliniam 8 quaſi gradibus ab auſtro in occaſum, Louanium 4 ab auſtro ad ortum, Bruxellas 25 ab auſtro in occaſum, Mittelburgum 30 ab occaſu ad Arctos, Bergas 20 ab Arctis in occaſum. Sintq; hæc loca ſatis pro exemplo, his habitis pono punctum in medio plani alicuius quod locum Antuerpiæ ſignificet, hinc duco circulū quem diuido in 4 adſcriptis 4 plagis mundi Oriens, Occidens, Meridies, Septentrio. Quadrantem deinde quemlibet diuido in 90 partes, aut ſaltem ſemicirculum in 180 gradus, poſt hæc ex puncto duco cuiq; locorum prædictorum lineam per ſuos gradus, & relinquo ita cartam imperfectam cum lineis tantum. Et me cum inſtrumentis confero Bruxellas, bvi iterum omnium quę viſu adſequi poſſum locorum lineas poſitionis quero. Inuenioq; Louanium ab ortu in meridiem vergere quaſi 14 gradibus. Machliniam & Liram in vna linea quæ diſtat ab ortu verſus Boream 47 gradibus. Gandauum 19 gradibus ab Arctis ad occaſum. Mittelburgum 33 gradibus eodem ordine. Bergas ab Arctis 9 gradibus in ortum declinare, quamuis ex Bruxellis hæc poſteriora duo non poſſint viſu conſpici, tamẽ adiecimus pro exemplo. Neq; volo quod quiſq; putet me hic veras lineas poſitionū aſſignare, ſed tantum pro declaratione communiſci. Inuentis igitur hoc modo lineis poſitionum quero in carta incepta lineam Bruxellę, in qua pono punctū diſtans ab Antuerpia quantum mihi placet, ex hoc iterum puncto duco circulum, quem ſeco primum per meridianum diſtantem a Meridiano Antuerpienſi vt ſolent parallelę lineę, ſimili modo diuido eū in 360 gradus, adſcriptis quattuor plagis mūdi vt iam ante cū Antuerpia egi. Demum ex centro quod iam Bruxellā ſignificat duco lineas poſitionū locorum præſcriptorum adiiciendo regulam centro & gradibus inuentis Vbi igitur nunc fit interſectio lineę Louanij cū priori quæ ex Antuerpia ducitur, ibi eſt locus Louanij. Atq; haud aliter inuenies omniū locorum puncta. Si vero contingat (vt nonnunq; vſu venit) quod vtraq; vice locus quiſpiam venerit in medio inter duo loca principalia ſiue primum nota: tunc neceſſe eſt tertia vice hunc locum ex trāſuerſo aſpicere. Atq; hoc modo non opus erit omnia prouincie deſcribendę loca

peragrare ſi tantũ videre, fluuios vero & littora facile deſcriptis oppidis ſecundum ſuas hinc diſtantias ortus & exitus habebuntur.

Hæc figura caput præcedens demonſtrat ad oculum.

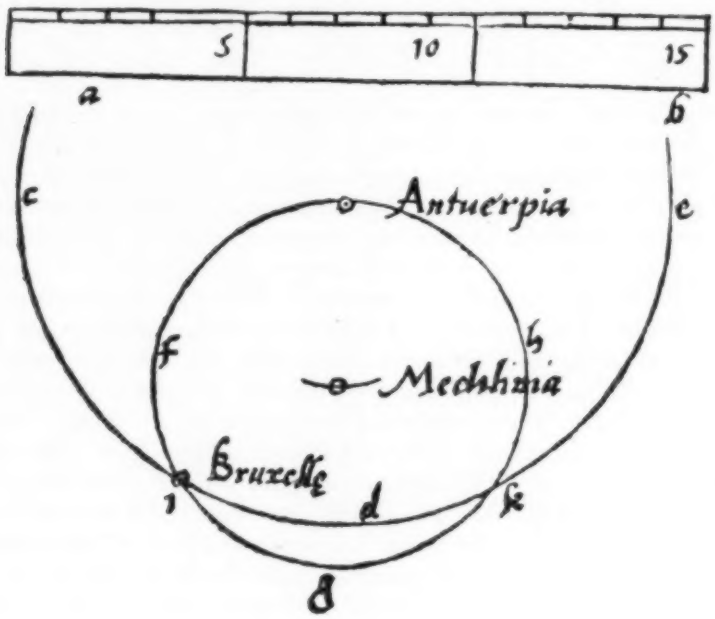


HÆc igitur diſcriptio & facilis eſt & altero modo qui per diſtantias operatur certior, nam illæ diſtantiæ fere incertæ ſunt, cum ob viarum atq; itinerum flexionem & ambitum, tum ob miliarium inæqualitatem: quę tamen modum paulo poſt deſcribemus & facilem etiam reddemus. Nunc autem ſi poſt deſcriptam hac ratione cartam placet incertas dimetiri diſtantias (quod tamen mirū videri poſſit quū hic nulla diſtantiæ habita ſit ratio) inquire aliquorum duorum locorum diſtantiam, aut per profectionem, aut certius per modum quem poſtea docebimus. Vt verbi gratia video inter Antuerpiam & Mechliniam quatuor eſſe miliaria parua. Quare ſpaciū inter Antuerpiā & Mechliniam in carta diuido per 4. Et per has diuiſiones potes dimetiri omnia loca in carta deſcripta.

CAPVT II.
De pingenda carta cognita ſola diſtantia locorum.

QVemadmodum in præcedenti capite oportuit vniuſcuiuſq; loci duas habere lineas poſitionis, ita hic cuiuſq; loci a duobus aliis locis diſtantias rectas res ipſa requirit. Datis igitur his, facile ipſa loca in cartam redigemus. Primum enim faciemus ſcalam miliarium ad libitum, ſecq; diuidendo vnam lineam quæ habeat longitudinem cartæ decribendæ, in tot miliaria quot regio deſcribenda fere habet. Deinde ponātur prima duo oppida aut loca ſecūdū ſuā diſtantiā ad libitum. Pro tertio vero neceſſe erit cognoſcere diſtantiam ab vtroq; poſito. Capta enim intra circinum ex ſcala diſtantia tertij ab vno poſitorum, mittatur pes circini in locum cognitum, & deſcribatur circulus obſcurus: eadem ratione capiatur diſtantia per circinum ab alio loco & ſimili modo deſcribatur circulus delebilis ex reliquo loco. Hi igitur duo circuli aut ſe mutuo ſecant, atq; id ipſum in duobus punctis, aut attingunt, idq; in puncto tantum. Si ergo tantum attingunt in ipſo contactu erit locus tertij oppidi. At ſi ſe ſecant circuli, tunc erit in altero duorum punctorum. Quod quidem cuilibet facile erit diſcernere, an ſecq; declinet oppidum in dextrum an ſiniſtram. Exemplum cape in tabella ſequenti. Conſtruo primum ſcalam miliarium 15 quæ ſit a, b, deinde pono primum Antuerpiam.

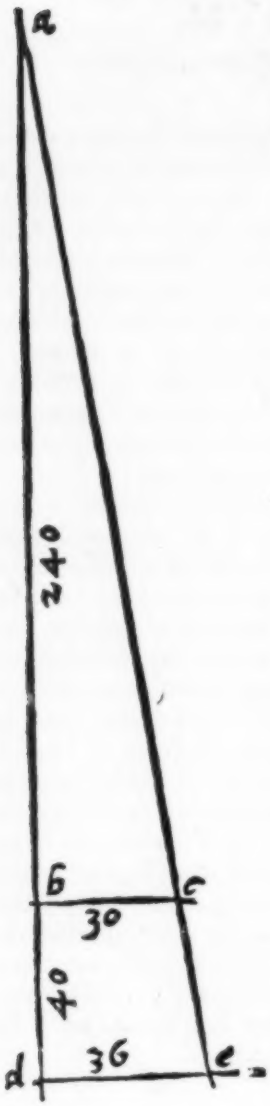
Et cum compertum ſit Mechliniam hinc diſtare. 4. milliaribus, diſtēdo circinum in ſcala ſecundum huiuſmodi diſtantiam, & poſito pede vno in puncto Antuerpiæ, facio altero pede notulam quæ ſit Mechlinia. Poſtea vt ponas Bruxellam accipe diſtantiam eius ab Antuerpia quæ eſt. 7. miliarium propter obliquitatē, & poſito pede circini vno in loco Antuerpiæ, altero deſcribe circulum vel arcū obſcurum qui ſit c,d,e. Simili via cape. 4. miliaria (nam tantum diſtat a Mechlinia) & ex puncto Mechliniæ deſcribe alium circulum qui ſit f,g,h, fit ergo hic interſectio duplex, i,k. Sed quum facile appareat Bruxellam magis tendere in occaſum quā Mechliniam ab Antuerpia, accipio pro Bruxella punctū, i, Non aliter facies de alijs locis. Vides igitur facilitatē huius artis ſi ſemper & in mari & in terris hæc diſtantia nobis in promptu eſſet. Quod per præcedentem modum primi capitis & in oceano & inter montes æque certum eſt, hic vero minime.



CAPVT TERTIVM.

De inuenienda diſtantia loci viſi quantumcunq; etiam diſtet.

SVperiori capite diximus quomodo per diſtantias locorum deſcribenda ſit carta. Verum quum omnino rectę diſtātię cognitione ad eam rem opus ſit, videtur mihi oportunum ſi quid de hac arte habeam nunc adducere. Viſa igitur turri alicuius oppidi, ſi diſtantiā eius a te libet inuenire. Potes primum abſq; aliquo fere inſtrumento mathematico hoc efficere. Elige igitur tibi campum aliquem latum, in quo poſſis huc & illuc ire & redire. Et quamuis non fuerit planus nō adeo refert. Accede primum ad turrim ex tuo loco ad ſpacium notum, ſc3 ad pedes 100. vel 200, & poſito ibi ſigno aliquo erecto, quod facile a longe videri poſſit, recede ab eo in vtrumuis latus etiam ad certam diſtantiam ſc3 50. vel 100 pedum, atq; hoc ſecundum rectum angulum a primo puncto, & iterum in tali loco pone ſignum aliquod erectum. Quo facto redi ad primum ſignum atq; ab eo retrogredere ad certam etiam diſtantiam quantum ſc3 placet, ea ratione, vt vbi deſiſtas, ſignum primum ſit directe intra viſum tuum & turrim viſam, ibiq; poſito ſigno tertio, diuerte hinc ſecundum rectum angulū in latus (vt prius) eo vſq; quo ſignum ſecundum ſit inter viſum tuum & turrim metiendam. Iam inueſtiga aut per pedes aut aliquod aliud genus menſurę diſtantiā primi ſigni a ſecundo, quę vocetur diſtantia prima. Item diſtantiam tertij a primo, quę ſit ſecunda: demum interſtitium tertij a quarto, quod ſit tertia diſtantia. Subduc igitur primam a tertia, reſiduum ſit diuiſor, poſtea multiplica tertiam diſtantiam per ſecundam, productum diuide per diuiſorem, quod ex partitione huiuſmodi prouenerit, oſtendet diſtantiam, a ſigno tertio vſq; ad turrim rectiſſimam. Pro cuius declaratione vide ſequentem figuram ibi, a, turris eſt metienda. b. ſignum primū c. ſignum ſecundū diſtans orthogonaliter a primo per 30 pedes. d. tertium ſignum, diſtans in recta linea retrorſum 40 pedes. e. quartum ſignum in latus recedens & in recta linea ipſius ſigni ſecundi cum turri, diſtans a tertio 36. pedibus, Subduco 30 de 36 reſtant 6, poſt hęc duco in inuicem 40 & 36 fiunt 1440 productum hoc diuido per 6 fiunt 240 pedes, quę eſt diſtantia inter. d. & a. turrim



Huius rei demonſtrationem ſi quis requirat Mathematicam ime adeat, nam in promptu habeo, quamuis hic non adijciã, neq; enim locus hic demonſtrationẽ ſed inſtructionem expoſtulat.

CAPVT IIII.

Docet idem per ſcalam altimetram aut Geometricam inuenire.

AD hanc rem opus erit inſtrumento magnæ vtcumq; quantitatis, nam inter omnia inſtrumenta Mathematica maiora ſunt certiora & vſui aptiora. Verum non erit neceſſe mihi hic ſcalę Geometricæ deſcriptionẽ apponere cum vulgaris ſit & cuiuis nota. Tantum hoc ſatis erit dixiſſe quod inſtrumentum debeat eſſe quale fere eſt dorſum Aſtrolabij cum indice volubili habens ab alio latere ex centro inſtrumenti pinnulam ferream qua ſuper baculo aut fuſte figi poſſit. Dimenſurus igitur loci viſi diſtantiam quantumuis longam, fige in campo vel agro baculum 5. vel. 6. pedũ. Huic ſuper impone per pinnulam inſtrumentum præſcriptum, poſitoq; indice ſuper linea diametrali ipſius inſtrumenti verte ipſum inſtrumentum cum indice eo vſq;, quo per indicis perſpicilla videas locum dimetiendum, fixo itaq; inſtrumento, verte indicem ad alteram diametrum

metrum tranſuerſam(ipſum enim inſtrumentum duabus diametris diſ-
ſectum eſſe debet) & recede ad eam partem in latus quam index indi-
cat ad certam aliquam diſtantiam, quæ quanto maior fuerit, tanto cer-
tior erit operatio. Hic iterum fige fuſtem vel baculum cui ipſum in-
ſtrumentum per pinnulam primum leuiter impone, deinde indice poſi
to ſuper diametro tranſuerſa ipſius inſtrumenti, verte inſtrumentum cū
indice ſuper linea ſua manente, quo vſq; per ipſius foramina priorē ba-
culum aſpicias quam rectiſſime atq; ita ipſum inſtrumētum firmiter ba-
culo affige. Dehinc vèrte indicem vt per ipſius perſpicilla rem dime
tiendam videas, atq; hic diligenter nota partes ſcalæ Geometricæ per
ipſum indicem abſciſſas, quas memoriæ vel tabellæ manda. Quibus
actis ſi diſtantiam inter duos baculos duxeris in omnes partes ſcalæ quę
ſunt fere in omnibus.12.& productum hinc numerum per partes ſcalæ
per indicem abſciſſas diuiſeris, prodibit loci vera diſtantia. Verbi gra-
tia ſit in ſequenti figura locus dimetiendus.a. B.vero ſignum ſtatio-
nis primæ, a quo in latus ſecundum angulum rectum diuer-
to ad.c.vbi index abſcindit.2.partes ſcalæ. Diſtan-
tia vero inter.b.&.c.ſit.200.pedum. Duco igi-
tur.200.in.12.prodeunt.2400. quæ diuido
per.2.fiunt.1200.pedes inter.a.&.b.
qui ſunt.240.paſſus, vel ſta-
dium vnū&.115.paſſus

CAPVT V.

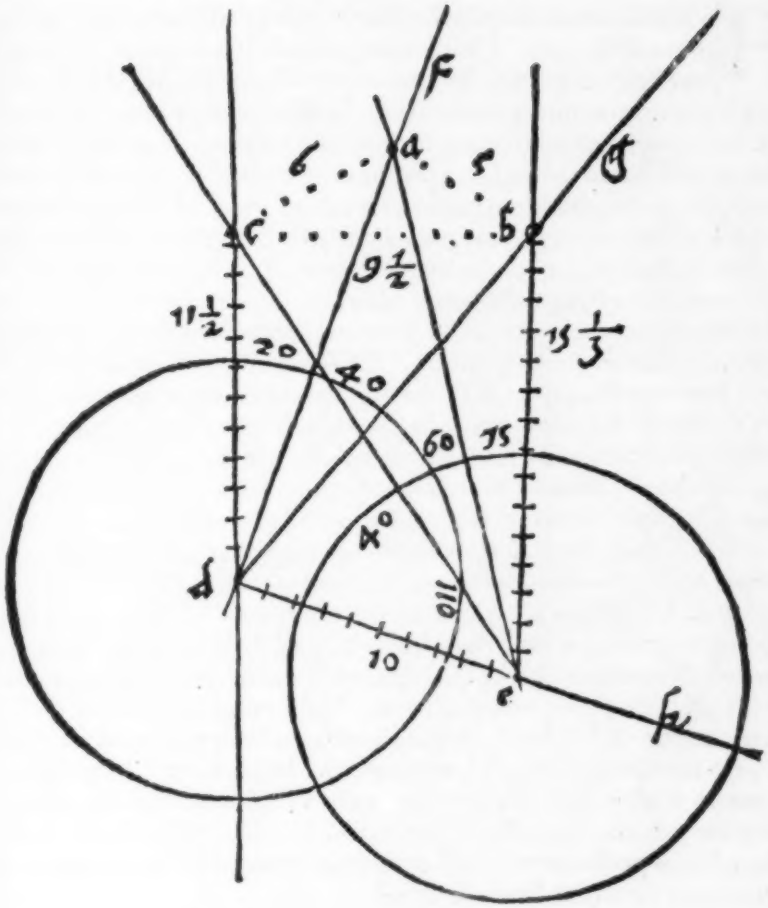
Duobus vel tribus visis locis, quomodo per angulos positionum rectæ eorum distantiæ sint inueniendæ, etiã si in nullo eorum præsens sis.

DIximus in principio de angulis positionum, qua scilicet ratione per illos loca describantur, nunc quomodo per eosdem ex duabus stationibus triũ vel quatuor locorum distantia vera sit inuestigãda docebimus. Repetatur igitur instrumentum in principio descriptum, cũ quo dimensurus accede campum, atq; ibi loca instrumentum, ita vt dimetiens ipsius respiciat vnum locorum dimentiendorũ, post hæc verte indicem ad omnia loca quæ vis dimetiri instrumento manente, & singulorũ angulos positionũ nota. Similiter angulũ positionis stationis secundę vel loci vbi altera vice stare velis, atq; eos in carta describe vel in tabula plana. Diuidendo scilicet circulum in plano per .360. partes siue gradus, & ex centro ipso per gradus ducẽdo angulos positionum, Prioris stationis loco signato recede in latus quantum placet, scilicet ad .300. pedes aut plus in linea tamen anguli positionis visi, atq; ibi rursus locato instrumento vt dimetiens siue linea meridiana instrumenti respiciat locum stationis prioris vide reliquorum locorũ angulos positionis. His habitis quære angulum positionis ipsius stationis secundæ a prima

prima, & ex centro circuli duc lineã per gradus positionum extensam quantum placet. In hac igitur pone centrum stationis secundæ a primo quantum placet, atq; ex eo duc circulum. Deinde diuide similiter hunc circulum in .360. partes, sumpto exordio à linea positionis quæ hic est dimetiens, postremo trahe lineas positionum locorum metiendorum quemadmodum per instrumentum expertus es in plano, quæ facient intersectiones cum prioribus. Vbi vero similis similem secat, ibi locus erit eius loci cuius est linea. Voco autem similes lineas quæ sunt eiusdem loci sed in diuersas partes ductæ. Iam vero vide quot sint pedes vel passus inter stationem primam & secundam. Ex qua intercapedine reliquorum locorum distantias sic inuenies. Diuide lineam quæ est a centro circuli primo ad reliquum, in tot partes quot vis, & per huiusmodi partes dimetire lineas inter quæuis loca designata. Postea duc partes tales quæ sunt inter duas sectiones vel loca, in distantiam duarũ stationum, productum diuide per partes quæ sunt inter duo centra, prodibit talium duorum locorum vera distantia. Simili ratione ages cum alijs, Sed cum obscurius paulo dixerim, declarabo idem per figuram.
Sint tria loca a. b. & c. volo eorum ab inuicem distantiam metiri, ita vt non opus sit mihi accedere aliquem eorum. Pono igitur instrumentũ meum in loco d. vbi ego sum, ita vt dimetiens siue linea meridiana instrumenti vergat ad c, deinde video, voluendo indicem, angulos positionum ipsius a. & b. & simul versus e. vbi erit statio mea secunda. Sũt autem inter c. & a. 20. gradus, item c. et b. 40. Item a linea c. d. ad e. 110 gradus. Describo ergo in tabella plana circulum cuius centrum sit d. dimetiẽs c, d, hunc diuido in 360. partes (vt solet) & deinde numero ex c. d. 20. gradus, per quos duco lineam d. f. respondet autem f. ipsi .a.
Item computo ex c. d. versus eandem partem 40. gradus pro ipso b. ducoq; lineam d. g. Postremo numero 110. gradus pro secunda statione, per quos describo lineam d. h. In hac linea pono aliud centrum distans a priori quantum libet, quod sit e. hinc describo circulum ex e. quẽ diuido in 360. gradus, incipiẽs a linea d, e, k. Dimissa nũc statione prior signata, pergo in latus secũdum lineam visam prius, ad 300. pedes, atq; hic iterum figo instrumentum, ita vt dimetiens ipsius respiciat signum stationis prioris, deinde respicio ipsum c. quod declinat a linea media 40. gradibus, ipsum a. 60 demum b. 75. Numero igitur hos gradus in circulo secũdo in plano descripto ex e. centro, & per eos duco ex e.

lineas, quæ ſecabunt priores. Notandum igitur eſt quæ lineę ſint eiuſdem loci, nam vbi ſe mutuo ſecant, ibi eſt punctus eius loci. Diuido nunc per circinum lineam d. e. in 10. partes, per quas dimetior diſtantias inter duas quaſcq; ſectiones ſiue puncta locorum, & quot de huius modi partibus continent multiplico per 300. productum, rurſus diuido per 10. & apparet mihi talium duorum locorum vera diſtantia. Vt quoniam inter ipſum a. & c. ſunt 6. partes huiuſmodi, dico per regulam proportionum, 10. dant 300. quantum dant 6. facit 180. quæ eſt diſtantia recta inter a. c.

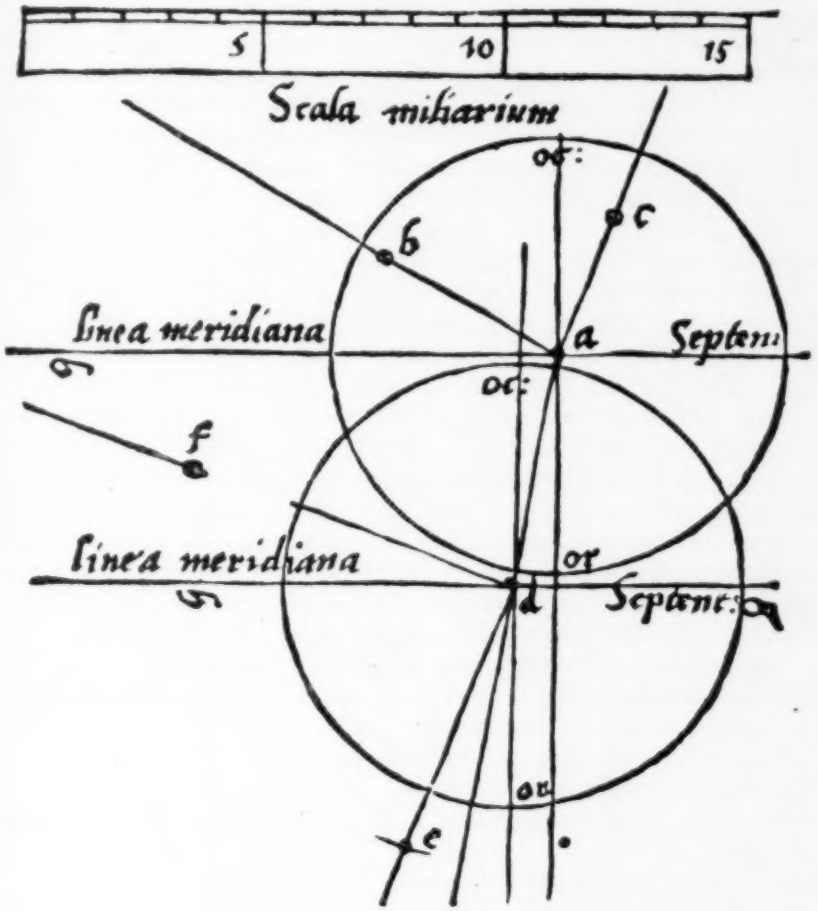
Eadem ratione licet ſcire diſtãtias d. c. | d. a. | d. b. | a. b. | c. b. | e. c. | e. a. | & e. g. |



CAPVT SEXTVM.

Tertius modus per distantiam & angulum positionis.

HIc modus omnino etiam facilis eſt, niſi quod duarum rerum cognitione ſit opus. Quibus per præcedentia cognitis, ponatur primus locus in carta ſecundum rei exigentiam, hoc eſt, ſi ſit medius regionis, ponatur in medio cartæ, ſin aliter ſecundum hoc ſituetur. Ex hoc igitur centro deſcribatur circulus diuiſus in 360. gradus poſitionum, quo facto ducantur lineæ poſitionum circumiacentium locorum ex centro, quemadmodum paulo ante expoſuimus. Poſt hæc deſcribatur ſcala miliarium pro magnitudine cartæ & regionis deſcribendæ. Ex hac ſcala capiatur cuiuſq; loci diſtantia, & poſito vno pede circini in centro, altero fiat punctum pro tali loco. Si nunc libet pergere. Accede vnum locorum prius deſcriptorum, atq; inde rurſus accipe aliorũ angulos poſitionum & diſtantias. Et alio circulo in carta deſcripto circa punctum huius loci, deſcribe diametrum eius quæ quidem reſpondet Auſtro & Aquiloni, ita vt ſit parallela diametro prioris, aut eadem continua ſi ſit in eadem linea meridiana, deinde circulo diuiſo vt prius age cum lineis poſitionum et diſtantijs circumiacentium, vt iam docuimus. Exemplo breui rem facilem dabo. Sit primus locus a. circumiacentia b. c. d. declinat b. ab auſtro in occaſum 30. c. ab occaſu in aquilonem 20. d. ab ortu in auſtrum 10. gradibus. Item diſtat b. 3. miliaribus, c. 4. d. 5. ab ipſo a. Deſcribo igitur circa a. circulum quem diuido in 360. gradus, deinde duco lineas b. c. & d. ſecundum ſuos angulos poſitionum ab a. quo facto capio ex ſcala miliarium miliaria cuiuſq; loci, & facio punctum in ſua linea. Nunc pergo ad ipſum d. Cui circumiacent e. & f. ipſum e, declinans ab ortu in occaſum 20. partibus, f. vero tantundem ab auſtro in occaſum. Item diſtat e. 6. miliaribus, f. autem 7. ab ipſo d. Deſcribo ergo circa d. alium circulum cuius diametrum g. h. duco parallelam priori a. h. Diuiſo dehinc circulo in 360. duco lineas poſitionum e. & f. poſtremo capio diſtantias ex ſcala miliarium atq; eas in ſuis lineis deſigno.



De longitudinis differentia cognoscenda ex latitudinis differentia & recta distantia.

CAPVT VII.

SVbducta latitudine vnius loci ab alterius loci latitudine, reſiduum vocatur differentia latitudinis, hanc igitur duc in. 15. miliaria germanica communia, ad quæ etiã debes reducere diſtantiã ipſam dando cuilibet miliariũ. 4000. paſſus. Numerũ miliarium hinc procreatum, ſubduc a vera diſtantia, reſiduum diuide per numerum miliariũ reſpondentem vni gradui longitudinis in latitudine media, hoc autẽ ſcies ex 15. cap. Apiani exemplo ſecundo vbi de longitudine agitur. Numerus ex huiuſmodi diuiſione prouemẽs (quem quotientẽ appellamus) oſtendet differentiam longitudinis. Exempli gratia:

Louanium habet la. 50. gra. 58. mi. Gandauum Flandriæ oppidum la. 51. gra. 30. mi. Differentia eſt. 32. min. quæ multiplico per. 15. fiunt. 480. minuta miliarium, quæ valent. 8. miliaria. Quia vero diſtant hæc duo loca. 14. miliaribus, demo inde. 8. reſtant. 6. miliaria, quæ diuido per 9. mil. 24. minuta (tot enim miliaria & minuta reſpondent vni gradui longitudinis in latitudine media) Verum quũ diuiſor ſit duplex, facio cũ totum minuta, multiplicãdo per. 60. fiunt. 540. minuta quibus addo. 24. ſunt. 604. minuta. Similiter ex numero diuidendo facio minuta. 360 Rurſus qa non poſſum diuidere. 360. p. 604. multiplico. 360. per 60. fiunt. 21600. ſecunda, quæ diuido per. 604. minuta, proueniunt. 35. minuta, quæ eſt differentia longitudinis inter Louaniũ & Gandauum. Sed hic opus eſſe video regulis diuiſionis phiſicæ quæ ſequuntur.

Si diuido, Integra per integra, proueniunt integra,
Integra per minuta, fit numerus cuius vnitas valet. 60. integra, ergo multiplica eum per. 60 fiunt integra,
Minuta per minuta, proueniunt integra.
Minuta per integra, proue. minuta
Minuta per ſecunda proue. numerus, quem multiplica per. 60. erunt integra.
Secunda per integra, proue. ſecunda
Secunda per minuta, proue. minuta
Secunda per ſecunda, proueniunt integra.

Simili modo de alijs minutis.

Sed quorſum (inquiet aliquis) pertinet cognitio huius differentiæ longitudinis? Hac cognita diſcetur longitudo alicuius loci ignota, modo alterius ſit nota. Si enim differentiam hanc adijcias vel adimas longitudini notæ, prodibit longitudo vera prius incognita. Dico autẽ adijcias vel adimas: nam ſi locus, cuius longitudo eſt incognita, ſit occidentalior altero, differentia eſt adimenda longitudini notæ, econtra adijci-

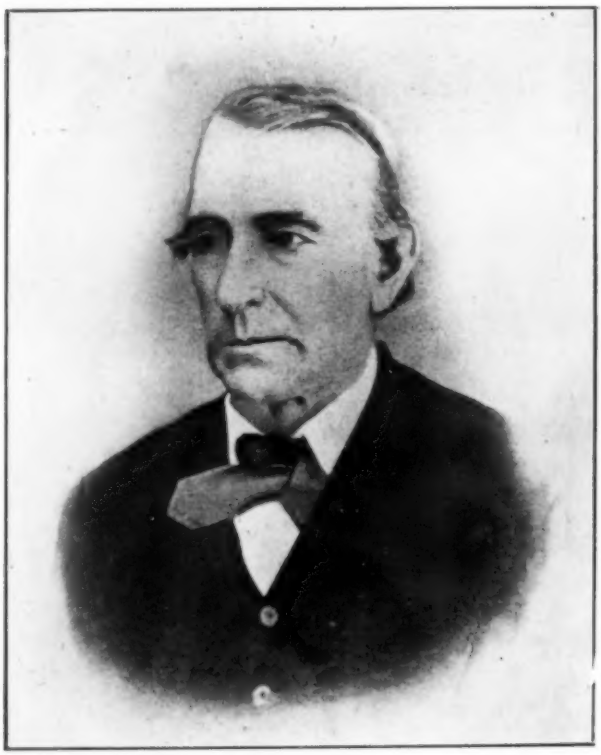
enda eſt ſi ſit orientalior, tum demũ exibit longitudo quæſita.

Hæc ſunt fere quæ mihi videbantur non incommode huic libello Apiani adijcienda, cũ quia eadem eſt materia, tum etiam hic meus ſine illo, aut illius ſine hoc meo imperfectus videri potuiſſet. Verum hoc vnum admonuiſſe volo, quicquid hic de cartis planis deſcribendis diximus, totum id (ſi ad minutum vſq; examinari debeat) imperfectũ eſſe. Nunq; enim in plano poterit deſcriptio fieri regionũ quæ ex oĩ parte ſit completa, etiã ſi ipſemet Ptolomæus redeat, nam aut longitudo omittetur regionum, aut diſtantia non ſeruabitur, aut ſitus negligetur, aut etiã duo horum, ratio eſt quod nulla ſit cognatio ſphæræ ad planum, quem admodum nec perfecti & imperfecti. Verum quũ in prouincia. 50. vel 100. miliarium hic error nullius momenti efficiatur, non adeo curandum eſt. Sed ſi totam Europam quis per hos modos deſcribere velit, commodiſſime hoc & certiſſime in ſphærico efficiet corpore, quod, quum non ſit vulgarium, hic miſſum facio.

Ioan. Grapheus typis cudebat Antuerpiæ,
Anno. M. D. XXXIII.
menſe Febr.

Scrutamini ſcripturas.

QVOTIES VOLVI CONGREGARE FILIOS TVOS QVEMADMODVM GALLINA CONGREGAT PVLLOS SVOS



Isis, XXII, pl. 20 Dr. DAVID ALTER W. A. HAMOR

David Alter and the Discovery of Spectrochemical Analysis

Many institutional and plant laboratories now make spectrochemical analyses, and the use of the spectroscope in scientific research and control is expanding rapidly. It seems, therefore, an appropriate time to note the part that several Americans had in the early development of spectrochemical analysis. It is commonly supposed that this branch of spectroscopy began with KIRCHHOFF and BUNSEN. These scientists were equipped with better instruments than were their predecessors, and were not only good observers but also well grounded in theory. It is true that they, by making accurate investigations of all the elements then available, and by clarifying some phases of the subject that had been quite hazy to earlier workers, put spectroscopy on a firm foundation. But in H. KAYSER's unexcelled history of spectroscopy KIRCHHOFF's studies are taken up well beyond the middle of the treatise.

Much has been written on the topic of priority in the discovery of spectrochemical analysis. There is, however, very little point to the discussion. The ideas grew slowly, with many setbacks, from the days of FRAUNHOFER and HERSCHEL. Before the epoch-making work of KIRCHHOFF and BUNSEN, the views of DAVID ALTER were the most clearly stated and the most comprehensive. This American scientist was evidently the first to suggest the value of the spectroscope in explaining several atmospheric phenomena that will be considered later.

The first to report that certain elements show characteristic spectra was the astronomer Sir JOHN HERSCHEL. In 1824 he demonstrated very clearly that a small quantity of an alkali can be detected by its flame spectrum. The results of this research were published in a journal that was well nigh inaccessible to the rest of the world, and before the paper was widely known its author had concluded that his former ideas must have been

incorrect. For in almost every source he investigated he found the strong orange lines that we now know to be associated with sodium. For many years—a whole generation, in fact—the prevalence of these sodium lines prevented one physicist after another from realizing that each element has a characteristic spectrum.

Many scientists after HERSCHEL and before KIRCHHOFF added to our knowledge of spectra; perhaps WHEATSTONE and ÅNGSTRÖM did the most for analysis. But previous to the publication of their researches, ALTER, who resided at Freeport, Pa., had contributed his first paper, " On Certain Physical Properties of Light, produced by the Combustion of Different Metals in the Electric Spark, refracted by a Prism," to the *American Journal of Science and Arts*, *18*, 55-57 (1854).

Before attempting an appraisal of this work of ALTER, let us briefly consider the author. DAVID ALTER was born in Allegheny township, Westmoreland county, Pennsylvania, on December 3, 1807, and died at Freeport, Armstrong county, September 18, 1881, not far from his birthplace. He was of German-Swiss extraction; his father, JOHN ALTER, was a millwright, and his maternal grandfather, PETER SHEETZ, was famous as a mechanician. Alter became interested in the wonders of electricity at the age of nine and later studied the few books on " natural philosophy " that he could borrow from several country physicians with whom he was friendly. He began the study of medicine after he was twenty-one and in 1831 was graduated from the Reformed Medical College of the United States, an eclectic institution in New York, N. Y. ALTER then engaged in the practice of his profession in Elderton, Pa., where he found time, however, to experiment in telegraphy; later, in 1837, he invented an electric motor and subsequently built a large electric clock and designed an electric locomotive. As indicated, ALTER did not possess a formal scientific education. Moreover, he did not have, in any of his researches, the benefit of scientific companionship or of a useful library. Lack of means usually compelled him to make his own instruments and even the tools and machinery with which to perform this work. His lenses, prisms, telescopes, and spectroscopes were of his own construction. He was one of the first Americans to utilize the photographic process of DAGUERRE and became a skilful operator, his daguerreotype of the dark lines

of the solar spectrum showing his mastery of the art. The prism he employed in his spectroscopic investigations was made from a mass of brilliant glass found in the pot of a glass factory destroyed in the great Pittsburgh fire of 1845. After locating in Freeport, Pa., ALTER became interested in the manufacture of bromine, an industry introduced by him in this country, and he also designed and operated a plant for the production of coal oil, the antecedent of petroleum kerosene.

It would appear, then, that spectroscopy was an avocation in ALTER's case. At that epoch spectroscopic observation was handicapped by lack of apparatus. It was not until nearly thirty years later that fine spectroscopic equipment could be readily obtained, and it is of interest that the early American development of these instruments was accomplished in the same district in which ALTER's spectrochemical observations had been made. Fostered by WILLIAM THAW and guided by LANGLEY and KEELER, the John A. Brashear Company of Pittsburgh produced spectroscopic equipment for an unusually wide range of purposes and of the highest quality. This firm prepared practically all the blanks for ROWLAND's gratings.

Returning to ALTER's publication, we find that the author records several phenomena that had already been described, but undoubtedly the pertinent literature was not available to him. Then he defines the spark spectra of several metals, concerning which little or nothing had ever been published. And for the first time it is clearly stated that each element has a characteristic spectrum. To emphasize the fact that ALTER understood this phenomenon, he can be quoted as follows: " ... two faint bands in the blue which are not always seen and are probably caused by an impurity in the metal." The author here speaks like a veteran spectrochemical analyst. He further points out that an alloy of two metals shows the lines of both constituents. The sodium lines did not discourage this investigator, who mentions that the orange line is always present.

ALTER's second paper, " On Certain Physical Properties of the Light of the Electric Spark, within Certain Gases, as seen through a Prism," appeared in the *American Journal of Science and Arts*, *19*, 213-214 (1855). In this report the spectra of hydrogen, air, and other gases are described. Here too it is found that

each substance has a characteristic spectrum. The brilliance of the red line of hydrogen discloses to ALTER that red lightning shows a path through moist air. He is of the opinion that the "colors of the aurora probably indicate the elements involved in that phenomenon." And further he says that "the prism may also detect the elements in shooting stars, or luminous meteors." Scientists were long in fulfilling ALTER's prophecy in the case of the green auroral line, and much of that spectrum remains to engage the attention of both astronomer and physicist. At present considerable attention is being devoted to the spectra of meteors, more for what scientific investigation has to reveal about our upper air than for a knowledge of the meteors themselves. These two predictions assure to ALTER a prominent place in the history of applied spectroscopy.

About the same time that ALTER's second paper appeared, WHEATSTONE's long continued researches were made public and ÅNGSTRÖM's word was translated from Scandinavian to English. It was no doubt due in large part to lack of proper facilities that these important discoveries were not immediately developed further by ALTER or by others. As it happened, little was done along the lines of spectrochemical analysis until after the remarkable studies of KIRCHHOFF and BUNSEN appeared, some five years later. Subsequently the subject was taken up by ROSCOE, who applied spectroscopic analysis to a variety of technologic problems. The industrial employment of the spectroscope lagged, however, until within the last decade. At present the investigations of the pioneers are bearing fruit, and it is very fitting that manufactures of ALTER's district are leading in the use of spectroscopy, while Pittsburgh's educational institutions and Mellon Institute of Industrial Research are prepared to assist those who realize that spectrochemical analysis can simplify or solve their problems.

Pittsburgh (Pa.) WILLIAM A. HAMOR

Note of acknowledgement.—Dr. KEIVIN BURNS, professor of astronomy in the University of Pittsburgh, generously aided in the writing of this paper; and Dr. DINSMORE ALTER, professor of astronomy in the University of Kansas, after reading the manuscript, kindly made several helpful suggestions that have been followed in preparing the article for publication. W. A. H.

The Admiral's Map
What was it? And who the Admiral?

Among the twenty maps included in the 1513 Strasbourg edition of CLAUDIUS PTOLEMY's Geographia are two which relate to New World discoveries. They are, in the order in which they are named on the title-page of the "Supplementum":

The "Hydrographia sive Charta marina...",

The "Tabula Oceani occidentalis seu Terre nove".

Of these the latter, although referred to in the index of maps under the above title and mentioned among those relating to Europe, actually bears the name "Tabula Terre Nove", and, because of the impression that it was based on geographical ideas derived more or less directly from COLUMBUS, has come to be very generally known as the "Admiral's Map". (1)

This is quite erroneous. Not only is there no extrinsic authority for calling the *Tabula Terre Nove* the Admiral's Map, but its New World configurations (far from being traceable to COLUMBUS) are unmistakably borrowed from the Portuguese cartographers—being almost exactly those of the CANTINO and CANERIO charts except for the fact that the northern and southern continents, unconnected on those maps, are here united.

This continuous coast-line, from some 55 degrees north to 35 degrees south latitude, is in itself evidence that the map did not originate with COLUMBUS. The indication of such a barrier in the way of Spain's westward route to India and the as yet vaguely located source of the coveted spice trade could not have proceeded from the Great Discoverer. He would have been the last person in the world to admit, still less suggest, its

(1) See JUSTIN WINSOR's "A Bibliography of Ptolemy's Geography", p. 11; also his "Narrative and Critical History", vol. II, p. 112; and JOHN FISKE's "Discovery of America", vol. II, pp. 77-78.

each substance has a characteristic spectrum. The brilliance of the red line of hydrogen discloses to ALTER that red lightning shows a path through moist air. He is of the opinion that the "colors of the aurora probably indicate the elements involved in that phenomenon." And further he says that "the prism may also detect the elements in shooting stars, or luminous meteors." Scientists were long in fulfilling ALTER's prophecy in the case of the green auroral line, and much of that spectrum remains to engage the attention of both astronomer and physicist. At present considerable attention is being devoted to the spectra of meteors, more for what scientific investigation has to reveal about our upper air than for a knowledge of the meteors themselves. These two predictions assure to ALTER a prominent place in the history of applied spectroscopy.

About the same time that ALTER's second paper appeared, WHEATSTONE's long continued researches were made public and ÅNGSTRÖM's word was translated from Scandinavian to English. It was no doubt due in large part to lack of proper facilities that these important discoveries were not immediately developed further by ALTER or by others. As it happened, little was done along the lines of spectrochemical analysis until after the remarkable studies of KIRCHHOFF and BUNSEN appeared, some five years later. Subsequently the subject was taken up by ROSCOE, who applied spectroscopic analysis to a variety of technologic problems. The industrial employment of the spectroscope lagged, however, until within the last decade. At present the investigations of the pioneers are bearing fruit, and it is very fitting that manufactures of ALTER's district are leading in the use of spectroscopy, while Pittsburgh's educational institutions and Mellon Institute of Industrial Research are prepared to assist those who realize that spectrochemical analysis can simplify or solve their problems.

Pittsburgh (Pa.) WILLIAM A. HAMOR

Note of acknowledgement.—Dr. KEIVIN BURNS, professor of astronomy in the University of Pittsburgh, generously aided in the writing of this paper; and Dr. DINSMORE ALTER, professor of astronomy in the University of Kansas, after reading the manuscript, kindly made several helpful suggestions that have been followed in preparing the article for publication. W. A. H.

The Admiral's Map
What was it? And who the Admiral?

Among the twenty maps included in the 1513 Strasbourg edition of CLAUDIUS PTOLEMY's Geographia are two which relate to New World discoveries. They are, in the order in which they are named on the title-page of the "Supplementum":

The "Hydrographia sive Charta marina...",

The "Tabula Oceani occidentalis seu Terre nove".

Of these the latter, although referred to in the index of maps under the above title and mentioned among those relating to Europe, actually bears the name "Tabula Terre Nove", and, because of the impression that it was based on geographical ideas derived more or less directly from COLUMBUS, has come to be very generally known as the "Admiral's Map". (1)

This is quite erroneous. Not only is there no extrinsic authority for calling the *Tabula Terre Nove* the Admiral's Map, but its New World configurations (far from being traceable to COLUMBUS) are unmistakably borrowed from the Portuguese cartographers—being almost exactly those of the CANTINO and CANERIO charts except for the fact that the northern and southern continents, unconnected on those maps, are here united.

This continuous coast-line, from some 55 degrees north to 35 degrees south latitude, is in itself evidence that the map did not originate with COLUMBUS. The indication of such a barrier in the way of Spain's westward route to India and the as yet vaguely located source of the coveted spice trade could not have proceeded from the Great Discoverer. He would have been the last person in the world to admit, still less suggest, its

(1) See JUSTIN WINSOR's "A Bibliography of Ptolemy's Geography", p. 11; also his "Narrative and Critical History", vol. II, p. 112; and JOHN FISKE's "Discovery of America", vol. II, pp. 77-78.

existence—even had he entertained that idea. No one could keep his own counsel better than COLUMBUS or, when expatiating upon a subject where he had something to withhold, say as much and at the same time tell less.

It is true that the *Tabula Terre Nove* bears the inscription: "*Hec terra cum adjacentibus insulis inuenta est per Columbum januensem ex mandato Regis Castelle*". (This land together with the adjacent islands was discovered by COLUMBUS the Genoese by command of the King of Castile). This, however, alludes to the original discovery of the southern continent by COLUMBUS in 1498—possibly also to his exploration of the Central American coast several years later—and has no reference to the union of the continents which is the only novel feature of this map.

The probability of such a connection was, so far as we know, first called attention to by VESPUCCI on the strength of the two voyages in which he participated under the flag of Castile, and was recorded as early as the year 1500 on the map of JUAN DE LA COSA. The *Tabula Terre Nove* (first printed in 1513) was unquestionably constructed at Saint-Dié in Lorraine by MARTIN WALDSEEMÜLLER, and cannot have been made earlier than 1507—after the demise of COLUMBUS—in which year the same cartographer also showed this striking configuration in the small inset map included in his remarkable cartographical masterpiece made known through the happy discovery by Father JOSEPH FISCHER at Wolfegg Castle (2).

Now the map which occupies the first place in the 1513 PTOLEMY bears the title *Orbis Typus Universalis Iuxta Hydrographorum Traditionem* (General Map of the World as derived from the Hydrographers) and is, as the context shows, the same as that listed in the index as the "Hydrographia sive Charta marina...". Also in the editors' announcement to the reader (the "Ad Lectorem") it is referred to simply as the "Charta Marina"—a designation not to be confused with WALDSEEMÜLLER's "Carta Marina" of 1516.

Further, in this "Ad Lectorem" (to be found on the *verso* of the title-page of the "Supplementum"), it is stated that the

(2) See "Die älteste Karte mit dem Namen Amerika aus dem Jahre 1507 und die Carta Marina aus dem Jahre 1516 des M. WALDSEEMÜLLER (Ilacomilus)", by JOSEPH FISCHER and FRANZ VON WIESER, Innsbruck, 1903.

geographical facts embodied in this " Charta Marina," have been made known " through the most authentic voyages of a former Admiral of the most serene King of Portugal, FERDINAND, and those of other explorers".

It is in this reference to a " former Admiral", rather than in any characteristic of the map itself, that the designation " Admiral's Map " had its inception. The name is therefore applicable only to this map—more properly known as the " Hydrographia ", the " Charta Marina ", and the " Orbis Typus Universalis :..."—and not to the *Tabula Terre Nove*.

But who was this Admiral spoken of as formerly in the service of FERDINAND, King of Portugal?

Inasmuch as FERDINAND was not king of Portugal, there are those who would substitute the name of King MANOEL, and think VESPUCCI to have been the admiral alluded to. To this it may properly be objected that the title Admiral was never applied to the Florentine in the records of the time: nor can it be shown that it was ever arrogated to himself by that sturdy mariner.

With more probability may it be urged that the word " Portugal " was a slip of the pen or a misprint, *Castile* being intended. In that day, as now, people were not always over careful in the way they expressed themselves. In a legend on WALDSEEMÜLLER's great world-map of 1516 both COLUMBUS and VESPUCCI are spoken of as Portuguese " capitaneos ".

It is of course equally true that FERDINAND was not king of Castile. But he is so spoken of even by VESPUCCI. And it will be recalled that FERDINAND—conjointly with Queen ISABELLA—signed the agreements at Santa-Fé, in 1492, which conferred upon COLUMBUS during his life-time, and upon his heirs and successors for ever, the office of Admiral in all lands and continents which he might discover or acquire in the Ocean-sea. It was thus restricted to the family of the original incumbent, and at the time of which we are speaking was held by his son DIEGO COLUMBUS whose wife, the Princess Doña MARÍA de Toledo, was kinswoman to King FERDINAND himself.

Yet the *Orbis Typus Universalis* which, alone, of the two maps in question has any claim to the name Admiral's Map has on its face less to associate it with COLUMBUS than has the *Tabula*

Terre Nove. It lacks all that reference to the discoverer so conspicuous in the latter, although certainly having the same Lusitanian prototype.

The resemblance, however, between this map and the CANTINO and CANERIO charts is such as to suggest that its maker had before him a facsimile—more probably of the latter or of the map from which it was derived—if not the CANERIO chart itself. In any case it may be assumed that the prototype of the *Orbis Typus Universalis* displayed the legends common to both those celebrated charts, namely: "*Toda esta terra he descoberta por mandado del Rey de castella*" (All this land was discovered by command of the King of Castile)—referring to the Venezuelan region of which COLUMBUS was the discoverer, and "*Has antilhas del Rey de castella descobertas por colonbo almjrante*" (The Antilles of the King of Castile discovered by the Admiral COLUMBUS)—referring to the West India islands. Inferentially, then, the constructor of the so called Admiral's Map would have accepted these Columbian traditions along with the geographical configurations which he so painstakingly followed.

This is not mere surmise. It is generally agreed that both the *Orbis Typus* and the *Tabula Terre Nove* were drawn by WALDSEEMÜLLER, and we have two other maps unquestionably also from his hand. All four are reminiscent of an identical Portuguese original. One of the latter two is the mappa-mundi brought to light at Wolfegg Castle and received as of earlier date than the *Orbis Typus Universalis* (3). The other, the Carta Marina of 1516, is of course later.

Of these, the map found by Father FISCHER makes use of the name America for the first time. The designation is however employed in a restricted sense, and refers only to the austral regions of which VESPUCCI was the first to give a written account. Even so it is qualified by a note or legend calling attention to the discovery of those coasts by CABRAL for Portugal. But the chief inscription of the map: "*Tota ista provincia inventa est per mandatum regis Castelle*" (borrowed by WALDSEEMÜLLER from his model) makes note of the prior discovery on the part

(3) See LOUIS C. KARPINSKI's admirable article: "The First Map with the Name America", pp. 664-668, in vol. XX of *The Geographical Review*, 1930.

of COLUMBUS, while a legend marking the approximate site of his landfall in 1498 declares that "*Iste insule per Columbum genuensem almirantem ex mandato regis Castelle inuente sunt*" (These islands were discovered by the Genoese Admiral COLUMBUS by command of the King of Castile)—the word *islands* here referring to what we now know to be part of the southern continent, as well as to the Antilles.

This fairly accurate apportionment of the honours of discovery between the Admiral COLUMBUS, CABRAL, and VESPUCCI is found restated in the 1516 Carta Marina, where a legend inscribed off the South American coast annouces that mainland to have been discovered about the year 1492 through repeated voyages on the part of the Spaniards and Portuguese. And it adds that of the commanders of those expeditions CHRISTOPHER COLUMBUS was the first; PEDRO ALVARES DE CABRAL the second; and, the third, AMERICUS VESPUCIUS (4).

Evidently WALDSEEMÜLLER, who formerly had concurred with his associates at Saint-Dié in ascribing to VESPUCCI the foremost place in the discovery of the New World, had come to realize the all important rôle played by COLUMBUS. And we may rest assured that it was with the preëminence of that great explorer in mind that the editors of the Strasbourg Ptolemy expressed themselves in their announcement to the reader as above quoted.

From what has been said it will, we think, be apparent that if the name Admiral's Map is to be given to any early cartographical document it should be accorded to that one which bears the title *Orbis Typus Universalis Iuxta Hydrographorum Traditionem*. Also there would seem to be no room for doubt that the "former Admiral" (quondam Almirantem), to whose voyages the Strasbourg editors chiefly attribute the new discoveries recorded on that map, is COLUMBUS.

Ann Arbor, Mich. U.S.A., SAMUEL M^{c} COSKRY STANTON.

(4) "Hec (regio) per Hispanos et Portugalenses frequentatis Navigationibus inventa circa annos Domini 1492 : quorum capitanei fuere Cristoferus Columbus Ianuensis primus, Petrus Aliares secundus, Albericusque Vesputius tertius."

The Course of Arabian Intellectual Development, 700-1300 A.D. A Study in Method

It is a methodologic truism that historians and social scientists in general are constantly compelled to make evaluative judgments in their treatment of intellectual history. The very selection of the historic data involves an implicit evaluation of the relative significance of the individuals, events and movements which are to be discussed—the " more important " being treated in preference to the " less important." A somewhat similar discriminatory procedure is attested by such descriptive phrases as : " scientific genius," " epoch-making discovery," " the most original contribution," " scientific advance (or decline)," *et cetera*. Estimates of this nature are of course prerequisite to the actual compilation and analysis of the data, and even the most extreme " objectivist " cannot cavil against them. If such procedure is regarded as scientific, there can scarcely be any objection to, or necessarily any more subjectivism in, the systematic utilisation of these estimates as a basis for the organisation of quantitative indices which would recapitulate the course of movement of a given culture or of a given social process. The numerical indices obtained may be used to chart the intellectual development of a culture with attendant heuristic advantages; for if the data of the historians upon which such " curves " are founded prove sound and reliable, and if the arrangement of indices is internally consistent, then the curves may provide a more comprehensive picture of the actual movement than would a series of separate judgments and descriptions.

The possibility of the intrusion of subjectivism—that is, individual, non-verifiable impressions—in the construction of such indices arises in the choice of a scale of numerical values into

which qualitative judgments—such as " important," " secondary," " greatest," etc.—are to be translated. Various studies using indices of the type mentioned have adopted each datum—scientific discovery, scientific paper, scientific journal, patent (for invention)—mentioned by chronologists as of equal significance and have hence assigned equivalent values to these " units " (1). It is obviously at this point that the fundamental problem of index-construction arises : shall each item—be it a scientific discovery, philosophical theory, art-creation or technologic invention—be assigned an equal numerical value, or a value varying according to its significance ? If the latter, what is to be the range of these numerical values ? If, for example, we assign a value of one to a philosopher of little note, shall the numerical value assigned to, say, AVERROËS, be five, ten, one hundred or one thousand ? This problem which, in an analogous fashion, arises for the historian when he seeks to determine which individuals shall be included in his treatise and the amount of space to be devoted to each, is the basic consideration in the compilation of " long-time indices."

To illustrate the method of constructing such indices, the precise nature of the above-mentioned difficulty and the type of results obtained from three different " scales of translation " of the qualitative judgments of a historian into quantitative indices, this paper will deal with the intellectual development of Arabian civilisation (2) from the eighth to the fourteenth century. Using Dr. SARTON's two volumes on the History of Science as the source of our data, we have tabulated, by fifty-year periods, the *comparative* importance of the contributions of Arabic-writing scientists and men of letters for the given period (3).

(1) Cf., e. g., F. J. COLE and N. B. EALES, " The History of Comparative Anatomy : A Statistical Analysis of the Literature," *Science Progress*, 1917 : XI : 578-596; T. J. RAINOFF, " Wave-like Fluctuations of Creative Productivity in the Development of West-European Physics in the Eighteenth and Nineteenth Centuries," *Isis*, 1929 : XII : 287-319; BORIS WEINBERG, " Les lois d'évolution des découvertes de l'humanité," *Revue générale des sciences*, 1926 : XXXVII : 43-47; W. F. OGBURN and S. C. GILFILLAN, " The Influence of Discovery and Invention," *Recent Social Trends in the United States*, New York and London, 1933, I, 122-166.

(2) This term refers to the Arabic-speaking peoples, for these, irrespective of racial or religious affiliations, truly comprised the Arabian civilisation of that period.

(3) GEORGE SARTON, *Introduction to the History of Science*, Baltimore: The WILLIAMS and WILKINS Company, 1927-1931.

Three different scales of translation were employed to convert Dr. SARTON's qualitative estimates of the various intellectual contributions. In the first compilation, each individual mentioned was given an equal value -1- in the field(s) to which he contributed (4). This amounts to an enumeration of the investigators of the time with the proviso that certain individuals—the polymaths—participated in more than one field and were correspondingly accredited (5). The second scale ranges from 1 to 3 " points." A value of 3 was assigned to those individuals who are described as having " had a very important influence," or as being " one of the greatest..." or as having " done very important work in the field," *etc.* To those who had made important contributions which were not, however, as significant as those made by persons placed in the preceding class, we assigned a value of 2. Finally, a value of 1 was given to each of the other individuals mentioned. In the third scale, the range is from 1 to 15. A weight of 15 " points " was assigned to each individual who was designated as, say, " one of the greatest physicians of all times." The individual who was held to be " one of the greatest scientists of the Middle Ages " was deemed worthy of a weight of ten points; " one of the greatest of Islam " was given seven points; " one of the greatest of his time " was given a weight varying from four to seven, dependent upon the general level of the intellectual contributions of the period; those " who had done very important work " in a given field were weighted with three points; individuals who had made somewhat less significant contributions were given a weight of 2; and lastly, those who were simply mentioned were weighted with one point.

To check the relative consistency of our method, the classi-

(4) Principles adopted by Dr. SARTON to govern the selection of individuals to be included in his *Introduction.* Viz. I, 41-42.

1. Not to mention an individual unless there were something specific to say about his activity, e.g., that he had invented the embryotome, or that he had been the first to make a spherical astrolabe, *etc.*

2. To name, so far as possible, the individuals who were the first to make a discovery or to suggest a theory, *etc.*

3. In determining the significance of an individual, to take into account the opinions of his contemporaries and of later scholars.

(5) In all three scales—cf. the following—if an individual contributed to several fields, a value was assigned, in accordance with the appropriate criteria, corresponding to his comparative importance in each field.

fication and " scoring " was performed twice for each scale of weights, of indices. There were some slight variations in the results but these were so small as to affect in no wise the general picture obtained from the initial compilations (6).

In the classification used in this study, mathematics, astronomy, and astrology are placed in one category, since any separation of these fields is practically impossible for the six centuries covered in this paper. Almost every mathematician was either an astronomer or an astrologer (7), and it hence seems fruitless to attempt to separate the two streams of development. In the field of physics, an homologous situation compels the inclusion of meteorology, optics and music. Chemistry should be understood to include alchemical research. The " natural history " category comprises mineralogy, zoology (treatises on falconry, husbandry, *etc.*) and botany. Medicine is taken to refer to investigations in anatomy, surgery, ophthalmology, physiology and therapeutics. Geography includes occasional works on geology and accounts of travels. By far the greatest part of technological inventions consists of instruments ancillary to the various sciences, as, for example, astrolabes, surgical instruments, chronometrical devices of different kinds, *etc.*, and for this reason the inventors are placed in the corresponding scientific category. " Humanistics " includes works in philosophy, theology, historiography, sociology, law, psychology and philology. This classification seems best suited to the purpose of the present survey (8).

The results obtained by each of the three " systems of translation " previously described, are presented in the following tables.

(6) Limitations of space preclude the introduction of the data for the second classification and scoring. For the first scale, there was no variation whatever; for the other two scales the variation for each field was in every case less than one per cent.

(7) Cf. SARTON, *Introduction...*, I, 544-545; II, 20, 122.

(8) Cf. Dr. and Mrs. CHARLES SINGER's Handlist of Scientific MSS. in the *Transactions of the Bibliographical Society*, 1917-19; also Dr. SARTON's classification in his *Introduction to the History of Science*.

TABLE I *
COMPARATIVE INTELLECTUAL DEVELOPMENT OF THE ARABIAN CIVILISATION

Period	Mathematics	Physics	Chemistry	Natural History	Medicine	Geography	Humanistics	Total
700-750							3	3
750-800	6	—	1	1	3	—	10	21
800-850	22	3	1	2	8	4	12	52
850-900	13	2	3	2	13	2	12	47
900-950	7	1	1	1	5	11	10	36
950-1000	15	—	4	3	13	4	21	60
1000-1050	11	4	3	2	12	2	10	44
1050-1100	6	1	—	2	3	2	10	24
1100-1150	10	4	1	4	9	5	18	51
1150-1200	10	2	1	8	6	4	28	59
1200-1250	5	3	3	5	10	4	26	56
1250-1300	9	5	3	6	7	8	19	57
TOTAL	114	25	21	36	89	46	179	510

TABLE II **
COMPARATIVE INTELLECTUAL DEVELOPMENT OF THE ARABIAN CIVILISATION

Period	Mathematics	Physics	Chemistry	Natural History	Medicine	Geography	Humanistics	Total
700-750							6	6
750-800	9	—	3	1	4	—	15	32
800-850	27	4	1	4	15	6	26	83
850-900	36	4	6	6	18	3	19	92
900-950	15	3	1	2	7	23	23	74
950-1000	30	—	9	8	22	9	43	121
1000-1050	28	8	5	5	22	6	28	102
1050-1100	19	2	—	3	7	6	18	55
1100-1150	21	6	1	5	16	11	34	94
1150-1200	14	2	1	11	12	11	45	96
1200-1250	10	4	3	12	11	9	44	93
1250-1300	13	7	5	10	11	19	37	102
TOTAL	222	40	35	67	145	103	338	950

* Based on the first scale of translation, *i. e.*, in which each contributor to a field was assigned a value of 1

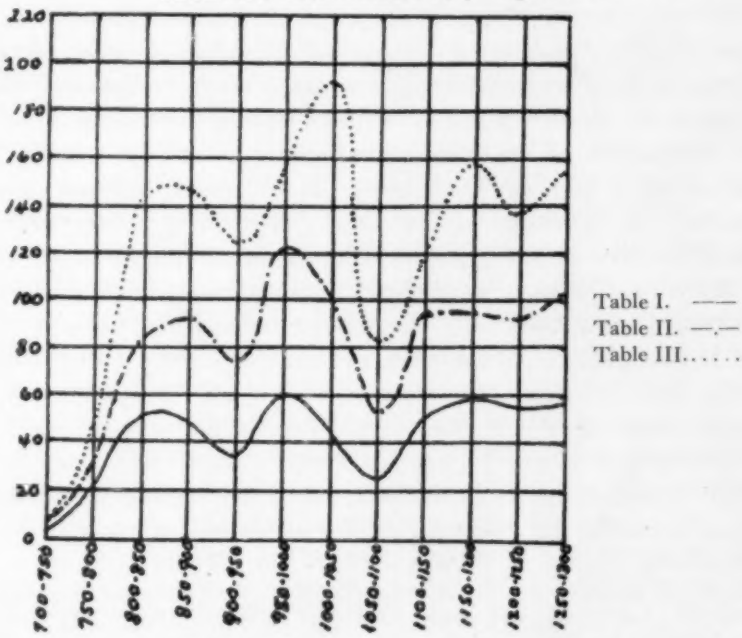
** Based on the second scale of translation, *i. e.*, in which the range of "values" is from 1 to 3 (cf. text).

TABLE III *
COMPARATIVE INTELLECTUAL DEVELOPMENT OF THE ARABIAN CIVILISATION

Period	Mathematics	Physics	Chemistry	Natural History	Medicine	Geography	Humanistics	Total
700-750							6	6
750-800	18	—	7	1	4	—	15	45
800-850	61	7	1	4	16	6	47	142
850-900	72	7	6	6	25	3	28	147
900-950	33	6	1	2	11	35	35	123
950-1000	52	—	9	8	29	9	49	156
1000-1050	48	21	5	5	43	18	56	196
1050-1100	27	2	—	3	7	6	37	82
1100-1150	25	14	1	5	23	11	40	119
1150-1200	23	2	1	18	26	22	67	159
1200-1250	18	4	3	12	17	20	64	138
1250-1300	25	14	5	10	19	26	58	157
TOTAL	402	77	39	74	220	156	502	1470

CHART I

COMPARATIVE INTELLECTUAL DEVELOPMENT OF THE ARABIAN CIVILISATION, 700-1300 A. D.



* Based on the third scale of translation, *i. e.*, in which the range of " values is from 1 to 15 (cf. text).

An analysis of the foregoing data will indicate first, the utility and significance of the general method (of constructing indices and charts to represent the movement of intellectual life), and second, the comparative advantages and disadvantages in each scheme of indices, in each scale of translation. A brief discussion will serve to indicate the more prominent of these factors.

In the first place, it will be noted that the tables provide a compact summary of the relative intellectual development as a whole during the period covered; further, of the comparative movements in the humanities and the sciences, and finally, within the latter group, of developments within specific sciences. Thus it is possible to compare the development of each science at different times during this period or to compare the degree to which each field has been cultivated. (For example, in Table III the ranking in point of total productivity of the sciences is: 1. Mathematics; 2. Medicine; 3. Geography; 4. Physics; 5. Natural History; 6. Chemistry) (9). Further, from Table I can be determined the degree to which the different fields engaged the attention of workers at various intervals. Likewise, the relative importance of performances in the humanities and the sciences can be gauged by a glance at the tables or, even more effectively, from appropriate graphs based on these data. Such are some of the heuristic advantages of these tabulations.

A comparison of the three curves derived from the tabulated data reveals a high degree of similarity in general outlines: the "waves" of development are almost completely synchronous. The differences are few and depend upon the varying assumptions in the three scales as to the possible range of significance of intellectual contributions. The curves derived from Tables I and II, for example, reach their peak in the second half of the tenth century, while the third curve—which represents the widest range of values—finds its climax a half century later. This difference is due to the fact that although the number of rather important figures in the latter tenth century was somewhat greater than in the following fifty-year period, there was but

(9) It will be noted that in the two other tables, the ranks—based on total productivity—of physics and natural history are inverted. This is due to the lesser range of the first two scales which does not permit the counterbalancing of mere *numbers* of contributions by the significance of particular advances.

one, ABŪ-L-WAFĀ, who could rank in the category of the later "intellectual giants," such as IBN SĪNĀ, AL BĪRŪNĪ, IBN YŪNUS, IBN AL-HAITHAM, 'ALĪ IBN 'ISĀ, *etc.* Hence, in the instance where such epochal contributions by a few supremely qualified individuals occur, a narrow range of numerical indices tends to obscure the actual course of movement. This difficulty inherent in the use of the first two scales, with narrow range, is somewhat relieved by the fact that an outstanding individual frequently gathers about him a cluster of less talented followers, so that in the computation of indices we generally find a correlation between the mere number and the importance of the intellectual contributions. Confirmation of this process may be found in the synchronism (with the above-mentioned exception) of the curves charted from our three scales of translation.

As is to be expected, the third scale presents the most pronounced rises and declines; the second scale, less marked fluctuations, and the first least of all. The correlation between the three scales of indices is highest, of course, in those instances when there is a dearth of supremely important contributions, for it is then that a narrow scale of values does not obscure the relatively small disparity in the significance of various developments. For example, there were ten contributors—of sufficient importance to be mentioned by Dr. SARTON—to the humanities from 750-800 and from 1000-1050 [see Table I], but in the first period they represented an achievement of 15 "points" while in the second they rated 56 "points" [see Table III]. Thus the first scale of simple enumeration completely obscured the undoubted difference in achievement between the two periods. The second scale—range of 1 to 3—differentiated the achievements to some extent but not as effectively as the third. In those instances, however, when there are no particularly important developments involved, as in physics from 800-850 and from 1200-1250, the three scales are of practically equal accuracy in denoting the actual trend. Further comparisons of specific differences and similarities in the results obtained from the use of the three scales of translation can be readily made by a study of the tables and the chart.

These results permit the following conclusions.

1. The essential similarity of the course of development

pictured by all three methods of translation seems to indicate that the curves are not misleading and that they reflect the actual movements in so far as these are accurately described by the qualitative judgments of the historian (10).

2. The equal-unit scale seems adequate if a very gross and approximate description is desired. The heuristic fiction of the equal significance of individual accomplishments offers a premium for mere quantity of output and completely disregards qualitative differences and is to this extent less adequate than the scale of translation which assigns unequal values proportionate to significance.

3. There is no objective criterion for the determination of the range of values which affords the most accurate description of intellectual development. If the range is too wide there is apt to be an undue emphasis placed upon the significance of a few individuals, in the mythopeic fashion of CARLYLE. This invidious tendency becomes accentuated by the fact that the great mass of relatively undistinguished scholars has already been eliminated by the historian so that the disparity between those who are actually discussed is comparatively small. Since a translation in terms of equal weights is not entirely misleading, a scale ranging from one to ten or fifteen seems to indicate the varying significance of different contributors while avoiding an underestimation of those many noteworthy individuals upon whose work so much of what we call genius is dependent.

Harvard University.
Cambridge, Mass.

PITIRIM A. SOROKIN.
ROBERT K. MERTON

(10) The senior author has made a similar investigation in the field of philosophical and of musical development from the sixth century B. C. to the present which yields results essentially similar to the above.

Notes and Correspondence

Query no. 46.—Sleeping along the meridian.

During a short stay in England in September 1932, I was interested and amused by a whole series of letters on this subject which appeared in the *Times*. I brought back with me a few cuttings and by means of the very precious index to the *Times* I was able later to read the letters which had escaped my attention or had appeared after my departure.

Mr. ARTHUR LOVELL started the ball rolling in the *Times* of Sept. 5 (p. 6, column *c*). I quote his letter verbatim as it appeared under the heading "Insomnia."

"May I draw attention to a point of great importance in the treatment of insomnia as well as the cultivation of sound and refreshing sleep? The influence of terrestrial magnetism on the human body is not taken into account by the medical profession, though irrefutable evidence has been adduced that about 40 per cent. of the human race are directly affected by it. REICHENBACH, the Austrian scientist, made an exhaustive series of experiments showing that sensitive persons, healthy and diseased, are affected beneficially when sleeping with head to the north, and adversely in other positions, particularly so when head is to the west, that is across instead of in line with the earth's magnetism. REICHENBACH's treatise was translated into English by two medical men, Dr. ASHBURNER, of London and Dr. GREGORY, Professor of Chemistry in the University of Edinburgh. Both corroborated REICHENBACH's conclusions. Sir WILLIAM HAMILTON mentioned GREGORY's work to two sisters, who immediately declared that one of them could never feel comfortable or sleep but when lying with head to north. Dr. EDWIN LEE published a book in 1866 confirming the original experiments.

The REICHENBACH quoted in this letter was KARL Freiherr VON REICHENBACH (Stuttgart 1788-Leipzig 1869), German industrial, chemist, and natural philosopher, who discovered or thought he had discovered a secret fluid which he named *od* by means of which he ventured to explain hypnotism, and the various terrestrial, physical and chemical influences exerted upon men. He defended his views in many publications, notably the *Physikalische-physiologische Untersuchungen über die Dynamide des Magnetismus usw. in ihren Beziehungen zur Lebenskraft* (2 vol., Braunschweig, 1850); *Odisch-magnetische Briefe* (Stuttgart, 1852); *Der sensitive Mensch und sein Verhalten zum Ode* (2 vol., Stuttgart, 1854-5).

The first work was soon translated into English by JOHN ASHBURNER : *Physico-physiological researches on the dynamics of magnetism, electricity, heat, light, crystallization and chemism in their relation to vital force* (title quoted from first American edition, New York, 1851). His views were the subject of considerable discussion not only in Germany and in England but all over Europe ; various works of his being translated not only in English, but in French and Italian (1), and bringing forth many other publications in confirmation or refutal.

REICHENBACH's views on the importance of sleeping along the meridian with the head to the north and the feet to the south, may be found in his *Physico-physiological researches* (§ 69, New York, 1851, 100).

These views are now generally forgotten, or more exactly their relationship with REICHENBACH is forgotten and I wonder whether they are not of more ancient origin? The letters which appeared in the *Times* would suggest that the idea of " sleeping along the meridian " goes back to much earlier times than the middle of last century. Is there no trace of it in mediaeval literature?

However, it is noteworthy that in the *Times* of Sept. 8, 1932 (6 c), Mr. K. G. UNNITHAN wrote " that exactly the opposite views are held by the ancient Hindus, who in various works... have said that people should never sleep with the head toward either N or W. A true Hindu, it is expected, should always sleep with the head toward either S or E." This was the only dissonant note in the magnetic concert, all other letters defending the notion of meridian sleep.

Times, Sept. 9, 1932 (6*e*). *Heads to the pole.*

Dr. VON DER FISCHWEILER of Magdeburg, who lived to be 109 ascribed his longevity to his constant habit of sleeping with his head toward north and his feet due south. Mr. C. L. DE WOLFF.

Times, Sept. 10, 1932 (6*d*).

Thirty six years ago a doctor at Langston, Hants, was called in to attend one of a family with whom I was staying. The patient's condition called for a lengthy stay in bed, and the doctor's first order was to turn the bed from E and W to N and S. This appears to have interested me for since that day I have experimented fairly regularly, and my experience has been that sleep comes most readily and holds one in most pleasant thrall when one lies parallel or nearly so to the magnetic meridian. Mr. ARTHUR LOVELL recommends the head to the N. but I have found that either head or foot to the N is all that matter. ARTHUR AKEHURST, Cornwall.

(1) For more information on this very strange personality see GUSTAVE THEODOR FECHNER : *Erinnerungen an die letzten Tage der Odlehre und ihres Urhebers* (59 p., Leipzig 1876). LADENBURG (ADB, 27, 670-1, 1888).

Times, Sept. 12, 1932 (6*c*). *Heads to the pole.*

The best-known example of the " north and south " sleeper was CHARLES DICKENS, who observed this rule at all times. It is recorded that in his " reading " travels in this country and the United States the first matter demanding attention in his bedroom was the orientation of his bed, and the joint efforts of DOLBY and himself were directed to hauling it to a position facing the south, if it was not already so placed. Mr. F. W. LANGSTON, Maidenhead.

Times, Sept. 13, 1932 (8*c*). *Heads to the Pole.*

" Mr. T. M. SNOW mentions a poem, current in Germany 25 years ago—the said poem is by CHRISTIAN MORGENSTERN and belongs to his 'PALMSTRÖM' series, it reads :

NACH NORDEN

PALMSTRÖM ist nervös geworden;
darum schläft er jetzt nach Norden.
Denn nach Osten, Westen, Süden
schlafen, heisst das Herz ermüden.
(Wenn nämlich man in Europen
lebt, nicht südlich in den Tropen.)
Solches steht bei zwei Gelehrten,
die auch DICKENS schon bekehrten—
und erklärt sich aus dem steten
Magnetismus des Planeten.
PALMSTRÖM also heilt sich örtlich
nimmt sein Bett und stellt es nördlich.
Und im Traum in einigen Fällen,
hört er den Polarfuchs bellen.

M. HOCHSCHILD. Frankfurt a.M.

Times, Sept. 16, 1932 (8*d*). *Heads to the pole.*

Some years ago I met a robust-looking farmer, who told me that he had suffered from insomnia and also kidney disease but by sleeping with his head to the N. and the foot of his bed rather higher than the head he had completely cured himself. While serving in China and India I found that the peasants of those countries when possible always sleep with their heads to the N. Major J. B. PAGET, London.

Times, Sept. 19, 1932 (8*e*). *Heads to the pole.*

Human beings are undoubtedly affected by the direction of their axis during sleep, but I am not so sure as is Major PAGET whether it matters if the head or the feet lie to the north so long as the main axis is due north and south. Since as a child of four one of my earliest memories of misery is having been placed in a bed east to west, wherein I awoke in the dark of midnight to find myself lying exactly at right angles across it, I have always been acutely conscious of the direction in which I sleep, and have noted with interest my little boy (before

he was three, and therefore quite incapable of having any psychological suggestion in the matter) was so sensitive to the north and south direction of his bed that he would spin round and come to rest north and south if his bed was placed at an angle to the north or south direction. Dr. MARIE C. STOPES, Heatherbank, Hindhead, Surrey.

Times, Oct. 11, 1932 (10*e*). *Heads to the pole.*

Having read with considerable interest the letter from Mr. ARTHUR LOVELL on the subject of insomnia, I determined to experiment by sleeping alternately with my head to the north and to the east. The results were so conclusive that they will, I hope, interest your readers. My wife and I both found that a night in our own room, with the bed turned north and south, even if greatly disturbed by our child, was enormously more refreshing than an undisturbed night in another room where the bed is east and west. After a "bad" night in our room we feel normal next day instead of washed out, as we formerly did. As a schoolmaster I cannot help feeling that if boys at school were considered in this way, and their beds rearranged where possible, they would make far more progress mentally and physically than they can under the present haphazard arrangements. It would be interesting to know whether any schoolmaster has already experimented on these lines with his boys and, if so, what have been his experiences. Mr. RALEIGH G. STRUTT, organist and choir master, St. Stephen's, Westminster.

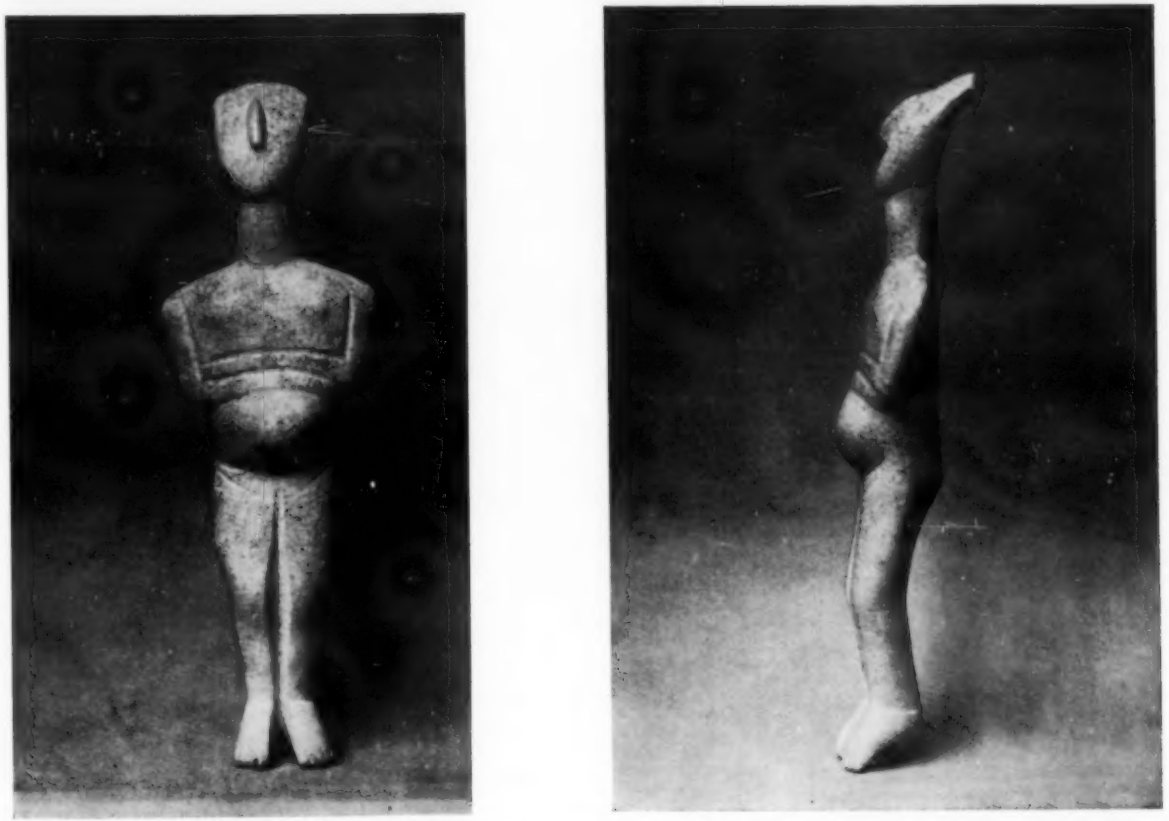
Times, Oct. 13, 1932 (10*e*). *Heads to the pole.*

Whether there is a real scientific basis for the benefit which is said to attach to sleeping with the head to the north I do not know. But I do know there is a certain element of danger—the danger that accompanies addiction to a fad or mascot, amulet or charm. Insomnia is a troublesome thing to treat, and the oddest things are sometimes effective cures. By all means let those who find it beneficial try it, but let them remember that they will be slaves to it thenceforth. They are happily situated if their life, habits, and environment permit of its permanence. Few are so situated, and most of us have to move about. Imagine the victim a commercial traveller or one who has to pay many visits! The disarranging of bedroom furniture, whether in a hotel or a friend's house, does not conduce to popularity, and might lead to dissensions that would effectually banish sleep even if the desired position were attained.—Dr. E. R. BARTON, County Mental Hospital, Gloucester.

I thought that these letters were sufficiently valuable as psychological documents (if for no other reason) to warrant their being reprinted in a journal which is available to more readers and is easier to consult than back volumes of the great London newspaper.

My query is: what is the source of these people's delusions? Except for the first, it is unlikely that they have ever heard of REICHENBACH. Did earlier writers entertain similar views?

A possible (indirect) source is the treatise "*Della rabdomanzia ossia elettrometria animale. Ricerche fisiche e storiche* (508 p., Milano, 1808)



MARBLE IDOL OF EARLY CYCLADIC DATE
(By courtesy of the British Museum)

by CARLO AMORETTI (1741-1816), which I know only through the *Bibliographical history of electricity and magnetism*, compiled by PAUL FLEURY MOTTELAY (London, 1922, p. 401) (2). However I have in mind other sources anterior to the nineteenth century, and even to the seventeenth.

REICHENBACH's od theory is casually mentioned in that fantastic hotch-potch, Mme HELENA PETROVNA BLAVATSKY's *Isis unveiled* (New York, 1877) (3), and it may thus have reached some peculiarly receptive ears but this does not help us to solve our problem which concerns the older tradition of that curious idea.

34.04.06 GEORGE SARTON.

Query no. 47.—Prehistoric representation and conception of pregnancy.

My attention was recently drawn to a note by E. J. FORSDYKE: A Cycladic idol, published in the *British Museum quarterly* (vol. 8, 108, 1934). The author reports very briefly (12 lines) the acquisition by Sir ARTHUR EVANS for the British Museum, of a marble idol of Early Cycladic date (c. 2500 B.C.) representing a woman in pregnancy. According to the author, there are other early examples of the same kind but this one is perhaps the most definite. Thanks to his courtesy, I obtained two photographs of it, together with the Museum's permission to publish them in *Isis*. The query is: What may have been the purpose of such a figure? Was it purely artistic and disinterested? or was there a magical aim or afterthought? As Mr. FORSDYKE remarks "A pregnant woman is not likely to have been chosen for a *ushabti* in the grave, nor even, in this pose, to have represented a Mother Goddess. The feet show, as in many other instances, that the figure is recumbent, and the folded arms seem to belong to the same pose. It probably represents an ordinary woman, perhaps with magical or religious reference to sexual functions."

How irrational primitive ideas on pregnancy may be was shown by BRONISLAW MALINOWSKI in his excellent book on *The sexual life of savages in north-western Melanesia* (2 vols., New York, 1929; *Isis* 13, 395-7). Bearing this in mind as well as the social and economic importance of such events, and the innumerable fertility rites, a magical purpose is plausible enough, but I do not see how it can be established.

GEORGE SARTON.

(2) *Isis* 6, 104-7.
(3) After MOTTELAY (p. 12, 401).

The study of the history of astronomy in Bamberg.—Thanks to the leadership of Dr. ERNST ZINNER, who has already put all the students of mediaeval science in his debt by his indispensable catalogue of astronomical manuscripts (1), the Observatory of Bamberg is now becoming a true center of research on the history of astronomy. Witness the following extract culled from his report published in the *Vierteljahrsschrift der Astronomischen Gesellschaft* (67 J., 131-3, 1932).

" Weitergeführt wurde der bereits früher erwähnte Zettelkatalog über ältere astronomische Werke, der nunmehr 17000 Nummern enthält, und der Zettelkatalog über Gelehrtenbildnisse. Dazu kam die Anlage eines Zettelkataloges über ältere astronomische Instrumente, fast alle vor 1850 hergestellt. Er umfasst Nachweise über 5511 Instrumente von 928 Herstellern, wobei über 1200 Bilder die Erklärungen unterstützen. Rechnet man dazu noch den Zettelkatalog über 14000 astronomische Handschriften — vor 1850, — so besteht nunmehr die Möglichkeit, mit Erfolg selbst solche Arbeiten anzufangen, die früher wegen ungenügender Kenntnisse der Einzelheiten nicht zugänglich waren. Es handelt sich um folgende Arbeiten, die im Berichtsjahr gefördert wurden :

1. Die Vorarbeiten zu einer würdigen Ehrung des aus dem fränkischen Städtchen Königsberg stammenden JOHANNES MÜLLER (REGIOMONTANUS), dessen Geburtstag am 6. Juni 1936 sich zum 500. Male jährt. Bekanntlich konnte er infolge seines frühen Todes nur einige Werke veröffentlichen. Die meisten seiner Werke wurden erst im 16. Jahrhundert und später veröffentlicht und sind zusammen mit den von ihm selbst veröffentlichten Werken so selten geworden, dass nur sehr grosse Bibliotheken sie besitzen. Nicht wenige seiner Werke sind aber verschollen. Einige davon gelang es in den letzten Jahren wiederzufinden. Bei anderen Werken, die natürlich nur handschriftlich vorhanden sind, kann erst eine eingehende Untersuchung der Schriftzüge und der anderen Eigentümlichkeiten lehren, ob es sich um Schriften MÜLLERS oder anderer Gelehrten des 15. Jahrhunderts handelt. Um einen Überblick über die in Betracht kommenden Handschriften zu erhalten, wurden bisher die grossen Bibliotheken von Deutschland, Österreich, Dänemark, Holland, Belgien, England und der Schweiz durchforscht. Eine Ausdehnung dieser Untersuchung auf andere europäische Länder ist nicht zu umgehen. Eine andere Untersuchung betrifft seine Bildnisse. Bisher konnten 5 angebliche Bildnisse festgestellt werden. Allerdings ist es sehr wahrscheinlich, dass es sich wie bei den meisten mittelalterlichen Gelehrten nicht um porträtähnliche Bildnisse, sondern um typische Gelehrtenbildnisse handelt. Erst eine eingehende Untersuchung kann eine Entscheidung bringen. Auch lässt sich auf Grund der Untersuchung der alten Instrumente des Germanischen Museums, soweit sie aus städtischem Besitz stammen, im Zusammenhang mit der Verwertung der älteren Nachrichten entscheiden, welche Instrumente noch von MÜLLER oder seinem Schüler B. WALTHER stammen und zugleich die mit MÜLLER beginnende und 1504 endende erste Nürnberger Beobachtungstätigkeit eingehend schildern. Neben diesen Voruntersuchungen gingen Verhandlungen wegen der Herausgabe seiner Lebensbeschreibung und seiner Werke. Soviel sich bis jetzt übersehen lässt, wird sich eine würdige Ehrung dieses bedeutenden und leider zu jung gestorbenen Gelehrten ermöglichen lassen.

(1) ERNST ZINNER : *Verzeichnis der astronomischen Handschriften des deutschen Kulturgebietes* (München 1925; *Isis* 15, 193-5).

2. Eine andere wichtige Untersuchung, die auch im Berichtsjahre gefördert werden konnte, ist die Sammlung der Beobachtungen über Himmelserscheinungen, welche in Europa, besonders im Deutschland in der Zeit von 900-1500 n. Chr. angestellt worden sind. Eine solche Sammlung erscheint wichtig, da die Nachforschung nach langen Perioden in der Erscheinung der Sonnenflecken, Kometen, Sternschnuppen, aber auch des Erdmagnetismus und des Wetters genaue Grundlagen benötigt und unsere bisherigen Kenntnisse zu lückenhaft sind, wie ein Vergleich des von J. WEISS veröffentlichten Verzeichnisses der in Deutschland vor dem Jahre 900 beobachteten Elementarereignisse mit den anderen, zufällig aufgefundenen Nachrichten beweist."

I take special pleasure in reproducing this report because nothing is more favorable to the progress of our studies than the constitution of such archives and centers of research, where materials may be systematically and continually accumulated, and safeguarded. The main difficulty, of course, is to establish a tradition of sufficient strength to insure the continuation of the work after the deaths of the promoter and of each successor, for the life time of even the most active and most devoted scholar is utterly insufficient for so great a task. May the Bamberg archives of the history of astronomy flourish many years under Dr. ZINNER's direction and may they continue to flourish and to increase after his death. GEORGE SARTON.

Unity history school, Rome 1935.—I have already spoken of the Unity history school organized by FRANCIS SYDNEY MARVIN in August 1915 at Woodbrooke, the educational settlement of the Society of Friends, some four miles out of Birmingham (see *Isis* 2, 425-27; 6, 119-21). It has now been arranged that a Unity School shall be held in Rome, at Easter, 1935. It will be organized in conjunction with the Institute for the study of the history of science in Rome, and has been approved by the Italian authorities. The subject will be Science in the modern world, and it is intended to arrange for a full week of sight-seeing in Rome, in addition to the course of lectures, for which it is hoped to secure a panel of international lecturers. Dr. FEDERIGO ENRIQUES, the head of the Institute in Rome, conducts the International Journal *Scientia*. A full programme will be issued later. Meanwhile we hope that many who have been to former "Schools" as well as new members, will be able to make plans to join us. Applications to the Hon. Sec.: Mrs. K. E. INNES, 29, High Oaks Road, Welwyn Garden City, Herts, England. G. S.

Prix Binoux 1934. — L'Académie des sciences vient d'attribuer, pour 1934, le prix Binoux à RAOUL COMBES [Histoire de la biologie

végétale en France (*Isis*, 21, 459)] et à PAUL BAUD (L'industrie chimique en France ; étude historique et géographique, 418 p., Masson, Paris, 1932). L. G.

Personalia. Dr. GEORGE SARTON, Associate of the Carnegie Institution, Editor of *Isis*, was elected a member of the American Philosophical Society on April 20, 1934.

Reviews

Geography of Claudius Ptolemy, translated into English and edited by EDWARD LUTHER STEVENSON, based upon Greek and Latin manuscripts and important late fifteenth and early sixteenth century printed editions, including reproductions of the maps from the Ebner Manuscript, ca. 1460, with an Introduction by Professor JOSEPH FISCHER, (S.J.). XVI+167 pp., 116 unnumbered pp. of reproductions, in folio. New York, The New York Public Library, 1932.

"Two hundred and fifty copies of this book have been printed on Charing handmade paper at the New York Public Library. Designed by JOHN ARCHER and printed under his supervision. Collotypes by MAX JAFFÉ of Vienna."

The external features of this sumptuous publication leave little to be desired. It is a beautiful book, elegantly printed on fine materials. The volume is further signalized by an introduction from the leading Ptolemaic scholar of this generation, Professor JOSEPH FISCHER, S.J., of Feldkirch, Austria, who discusses briefly the chief problems of the *Geography*.

The occasion of the undertaking seems to have been the possession of the Ebner MS. by the New York Public Library. The reproductions of its twenty-seven maps, together with two early printed maps, occupy nearly half of the volume. Concerning the MS. itself STEVENSON gives us only a meagre statement in the Preface. "The Codex Ebnerianus is a copy of the *Geography* prepared by DONNUS NICOLAUS GERMANUS, great indeed as a geographical editor and copyist, the maps in this manuscript being largely taken as a basis for the earliest printed editions."

For further information we must turn to FISCHER's recent monumental work, *de Cl. Ptolemaei vita operibus geographia praesertim eiusque fatis* (*Claudi Ptolemaei Geographiae codex Urbinas graecus* 82, *tomus prodromus*, Leiden, 1932), pp. 340-342, where we learn that the New York MS. contains PTOLEMY's *Geography* as translated into Latin by JACOBUS ANGELUS (*ca.* 1406), followed by the twenty-seven Ptolemaic maps as revised by DONNUS NICOLAUS GERMANUS (*ca.* 1466). NICOLAUS' chief

contribution to the Ptolemaic tradition is the so-called Donis-projection, which attempts to represent the convergence of the meridians by plotting both the upper and the lower parallel of the map in true proportion. PTOLEMY's rectangular maps are thus transformed into trapezoids, and so they appear in the New York MS. FISCHER shows that the maps in the famous copper-plate Roman edition of 1478 and its successors were taken from this very MS. He further identifies it with a MS. owned by WILHELM EBNER of Nürnberg, described in 1737 by RAIDELIUS, the first student of Ptolemaic MSS.; and it is on the basis of this identification that it is called the Codex Ebnerianus. The first page bears the heraldic plate of an early owner, which it would have been well to reproduce, as FISCHER was unable to identify it. The Codex Ebnerianus is in the Lenox Library, now a part of the New York Public Library.

Only the maps and the text that directly accompanies them (VIII 3-28) are reproduced from the MS. The rest of the Latin text is replaced by an English translation, which ends, however, after VIII 2, where the reproductions begin. The translator has thus left his task incomplete, since a Latin version in a Renaissance MS. is not a satisfactory substitute for the last chapters of the *Geography*, which involve many of the most vexed problems in the whole field of Ptolemaic studies.

The translation of PTOLEMY's *Geography* is a formidable task because of its complicated technical arguments in the first book and its 8000 untractable place names which form the substance of books II-VII. In addition to these difficulties, both FISCHER and STEVENSON complain of the lack of a satisfactory edition. Although the only comprehensive critical edition, by CARL MÜLLER in the DIDOT series, is unfinished, I feel that the translator has exaggerated this obstacle. Even before MÜLLER, the editors WILBERG and NOBBE were in possession of readings from representatives of the main branches of the tradition. It would have been possible to produce a fairly adequate translation by following these editions in the light of a discriminating knowledge of the problems of the text.

But instead of doing so STEVENSON has based his translation "upon Greek and Latin manuscripts and important late fifteenth and early sixteenth century editions," "and, it may be further noted, upon the critical texts and studies of WILBERG and MÜLLER" (apparently by afterthought). Since the Greek text was not printed until 1533 (by FROBEN at Basle), most of STEVENSON's early editions must have been in Latin. Now while there is an ample mediaeval tradition of PTOLEMY's *Geography* in Greek, there is no mediaeval tradition of it at all in Latin. The Latin texts were translated from Greek in the Renaissance, presumably, if not demonstrably, from extant Greek MSS. They are,

therefore, entirely secondary and should have no place in the basis of the *Geography* either in Greek or in English. Their only possible value in this respect would be for suggestive interpretation, and even that would be negligible. For the scholars of the Renaissance fell short of the ancient Greeks in scientific knowledge and were unable to understand classical works well enough to contribute anything of permanent value to their interpretation. Nevertheless STEVENSON seems to have used their translations extensively and to have called in Renaissance Latin texts to improve on MÜLLER's critical Greek text, ostensibly because " no one edition is alone a safe guide." It is evident *a priori* that this procedure is radically wrong.

A cursory inspection of the translation proves that the claim to have used these secondary and deterior sources is only too true. We may begin with the geographical names, which " have been given as in the original Latin or Greek texts." The following examples, which could be multiplied by the dozen, will illustrate how this principle is carried out : Britannicus ocean, Germanicus ocean, Hyrcanium sea, Pamphylium sea, Gangeticus bay, Tarentinus bay, Longum promontory, Longus river, Sacer river, Sacer mountain, Sacrum promontory, Pulcher harbor, Herculis harbor, Herculis straight, Herculis promontory, Atheniensium harbor, Gabrantuicorum bay, Thebae Phthiotidis, Pelasgiota. It will be observed that many words are translated into Latin instead of English. Although we grant freely that it is difficult to translate such material from one language into another, it still seems a strange expedient to translate it into a third language, unless perchance the names should be native in that language. In the above instances we cannot escape suspecting that the Greek never entered into the account, and that STEVENSON found the names in Latin and left them there. But even so they are handled very unskilfully. English substantives are modified by Latin attributives, and the gender and case endings of the latter are thus left without meaning. The result is an ill-digested mess of words that make neither Latin nor English, to say nothing of Greek.

Before leaving the geographical names we must state that STEVENSON's handling of them is also very inconsistent. The examples cited above are by no means followed systematically throughout the work. The same name often appears in several different linguistic and orthographical forms in the course of a single chapter. The orthography has a further tinge of Italicism, which points again to the feet of clay upon which the statue stands, viz. Myotis, Strimon, Hechatompilum, Bosphorus, Oputi (for Opuntii, Opūtij). In addition to these categories there are innumerable other errors that defy analysis and must be credited to

carelessness and ignorance. Even in such commonplace matters as the names of provinces the treatment is thoroughly unsatisfactory. The table of contents for the second book is enough to set one's teeth on edge with its Hispanic Baetica, Aquitainian Gaul, Narbonensian Gaul, Vindelica. These errors are not misprints; for the volume bears evidence of unusually accurate proofreading. There are scarcely any misplaced letters or marks of punctuation.

After this superficial inspection it is with reduced expectations that we approach the involved technical matter in the first book, in spite of the fact that even FISCHER assures us in his introduction " that the English translation of Dr. STEVENSON makes it easy for us to follow the arguments of PTOLEMY." We may credit FISCHER with having never seen the translation. The student of ancient science, who has long avoided PTOLEMY's difficult Greek, will grasp at this opportunity to take a short cut; but he will be keenly disappointed when he finds the road so rough that he has to turn back. For to speak the plain truth, there is not a single paragraph that does not betray some essential and often gross error. In only the simplest passages has the translator succeeded in carrying the thought from one sentence to the next. No one could follow PTOLEMY's arguments in this disguise, the expert least of all. It would be futile to try to enumerate the mistakes; for they are numberless and follow so thick and fast that it is impossible to single them out. I shall merely mention a few to demonstrate their calibre, and trust that the reader will be convinced of the rest.

In the opening paragraph of the *Geography* PTOLEMY distinguishes geography from chorography and itemizes respectively the subjects that properly come within the scope of these sciences. The list of geographical subjects appears in two different versions in the MSS. The first edition of 1533, the standard editions of NOBBE and MÜLLER, and probably all the editions between, print the better of these two versions : *οἷον κόλπων καὶ πόλεων μεγάλων, ἐθνῶν τε καὶ ποταμῶν τῶν ἀξιολογωτέρων* (I 1, 2). Nevertheless STEVENSON translates the other version : *οἷον κωμῶν μεγάλων καὶ πόλεων μεγάλων, ἔτι δὲ ὀρῶν καὶ ποταμῶν τῶν ἀξιολογοτέρων* : " such as the larger towns and great cities, the mountain ranges and the principal rivers." It is again noteworthy that this inferior version appears also in the fifteenth century editions of JACOBUS ANGELUS' Latin translation : *veluti circa maiora oppida, magnas civitates, montes etiam fluviosque insigniores.*

Occasionally also STEVENSON's errors seem to originate in Latin instead of Greek. In I 3, 1 PTOLEMY speaks of a ' straight distance ' (*ἰθυτενῆ διάστασιν*), which is translated as " correct distance," apparently from the Latin *rectam distantiam*. In I 18, 1 PTOLEMY passes from his

introductory remarks to the specific discussion of drawing the map of the world. He alludes to these preliminary topics as " matters proper to the science itself which required some explanation " (*τὰ κατ' αὐτὴν τὴν ἱστορίαν ὀφείλοντα τυχεῖν τινος ἐπιστάσεως*). Out of this prosaic phrase STEVENSON gets, " What is worth remembering in tradition and story," again apparently from ANGELUS' translation, ***quae iuxta traditionem historiae memoratu quodam digna fuerint***.

The misunderstanding of single words often may lead to serious errors. In one such case STEVENSON has certainly exposed himself to ridicule. In discussing the maps of his predecessors PTOLEMY explains that MARINUS preserved the correct proportion only on the parallel of Rhodes, where the ratio between a degree of longitude and a degree of latitude was about four to five (*τὸν ἐπιτέταρτον ἔγγιστα λόγον*, I 20, 5). In STEVENSON's translation this phrase appears as " almost exactly the method of Epitecartus," and the monstrosity is put beyond a doubt by being repeated at least twice (I 21, 2; 24, 2). ANGELUS had translated ***rationem fere epitetarti*** and so it was printed in the Roman edition of 1478, although I find that in later editions, such as that of 1490, the word ***sesquiquartam*** has been substituted.

It is impossible, however, to blame all of STEVENSON's shortcomings on JACOBUS ANGELUS; for often when the Renaissance Italian does very well, the modern American is as bad as ever. In I 14, 4 STEVENSON speaks of " the parallel drawn through Aromata to Prasum," whereas PTOLEMY makes it a point that these two places differed 20° 30' in latitude, being situated on the east coast of Africa more than a twenty day's voyage apart. STEVENSON makes this mistake by skipping from *ὁ διὰ τῶν 'Αρωμάτων παράλληλος* to *ἀπὸ τῶν 'Αρωμάτων ἐπὶ το Πράσον* and omitting the dozen intervening words entirely, perhaps through ***homoeoteleuton***. A similar omission occurs in I 22, 2, where the fifteen words from *ἐχέτω* to *μεσημβρινούς* are passed over. In both of these instances ANGELUS' translation is quite sound.

An especially fertile source of error in STEVENSON's translation is the failure to comprehend the syntax of words, phrases and clauses. It is of course impossible to preserve sentence structure intact in a translation; but nevertheless the relation of the ideas should in some way be reproduced. STEVENSON seems to have ignored this aspect of language a great deal of the time. For in his translation conditions and conclusions, causes and effects, statements, hypotheses and quotations are confused beyond recognition. Not only is the sentence structure completely shattered, but its ***disiecta membra*** become involved in a neighboring complex. Thus in VII 5, 3 the first words *τῶν δὲ περιλαμβανομέι ων ὑπὸ τῆς οἰκουμένης θαλασσῶν*, which form a partitive genitive, are

translated as a separate sentence belonging to the preceding paragraph : " The water moreover is much greater in extent than the land." STEVENSON's paragraphs often divide a sentence in this manner; and the error is the more striking since in the standard editions the sentences are not only distinguished by punctuation, but also by the numbers of the sections.

But it is clear by this time that STEVENSON's translation has little to do with standard editions. It ignores the best basis of PTOLEMY's *Geography*, the most up-to-date critical Greek texts, and resorts to what is probably the worst basis, the Renaissance Latin translations. The reason for this mistaken procedure is probably that STEVENSON was especially familiar with the latter and especially ignorant of the former. As a student of the history of modern geography, he was naturally much interested in the channels through which PTOLEMY's influence reached the fertile field of modern science. At the same time he knew little about the remote origins of this influence and had no training in handling the works of antiquity—" small Latin and less Greek," to say nothing of the technique of criticism and translation. His performance in these capacities betrays the amateur and dilettante at every turn.

The translation is a complete failure. Whatever value the publication has must be sought in the reproductions of the maps, and even this is not very great. On the one hand, the Codex Ebnerianus is outranked by an autograph MS. of NICOLAUS GERMANUS' maps in the Biblioteca Nazionale at Naples; and on the other hand the Codex Ebnerianus had already been reproduced in the copper plate maps of the Roman editions of 1478, 1490, 1507, 1508. The same plates were used apparently for all of these editions. In delineation they correspond very closely with the New York photographic reproductions; and in color they are equivalent, since neither reproduction portrays color at all. Thus the recent reproduction only slightly improves our knowledge of a comparatively unimportant source of the Ptolemaic tradition. Even in numbers and price it offers small advantage; for it is limited to 250 copies and costs $60.00. The old editions will scarcely be less accessible.

This sumptuous publication, therefore, will be of very little use to scholarship. The fine materials on which it is printed are worse than wasted, because they serve to impose its miserable contents on the unsuspecting student. It is unfortunate indeed that such an incompetent undertaking should find such lavish support in this country at a time when many worthy scholarly projects go begging. Possibly this was not merely an incidental occurrence, but rather the result of a tendency in some quarters to regard the works of antiquity as monuments of ignorance instead of enlightenment. They would accordingly be unworthy of serious attention or careful study. Such a view should be vigorously

protested. We hope it was through lack of due consideration and not through a fixed heresy that the present breach of scholarship was countenanced by so outstanding an institution as the New York Public Library. AUBREY DILLER.

Max Meyerhof.—*(Al-morchid fi'l-kohhl)* ou *Le guide d'oculistique*. Ouvrage inédit de l'oculiste arabe-espagnol MOHAMMAD IBN QASSOŪM IBN ASLAM AL-GHĀFIQĪ (XII^e siècle). Traduction des parties ophtalmologiques d'après le manuscrit conservé à la bibliothèque de l'Escurial. 225 p. Laboratoires du Nord de l'Espagne, Directeur : J. LUSI, Pharmacien. Masnou, Barcelone, 1933.

L'ophtalmologie est une des parties les plus précieuses et les plus originales de la médecine arabe, et notre savant confrère et ami, le Dr. MEYERHOF du Caire, a consacré à son étude depuis de longues années les loisirs restreints que lui laisse la plus exigeante des professions. Ce faisant il a suivi l'exemple de JULIUS HIRSCHBERG (1843-1925), mais il a sur son illustre devancier l'avantage inappréciable de pouvoir lire lui-même les textes arabes. La traduction en deux temps, d'abord purement linguistique par un orientaliste, ensuite technique par un spécialiste, présente toujours des dangers, quelle que soit la prudence des collaborateurs. Ces dangers, MAX MEYERHOF peut les éviter, car il connaît également bien l'oculistique et l'arabe, et lorsqu'il entreprend l'étude d'un vieux texte médical il a à sa disposition immédiate tous les genres d'expérience nécessaires. Nous lui devons plusieurs mémoires importants sur l'oculistique arabe, qui ont été signalés ici à mesure qu'ils paraissaient. Je ne rappellerai que sa belle édition du texte arabe avec traduction anglaise des *Dix traités sur l'œil* de ḤUNAIN IBN ʾISḤĀQ — le plus ancien traité systématique d'oculistique, découvert par lui-même (Le Caire, 1928; *Isis* 13, 106-9). Mon compte rendu de cet ouvrage contient une liste (empruntée à l'auteur) des traités d'oculistique arabes du IX^e siècle de notre ère au commencement du XI^e. Depuis j'ai eu l'occasion de résumer cet admirable chapitre de la médecine arabe dans mon *Introduction* (vol. 2, 82-4), mais MEYERHOF est beaucoup plus catégorique et n'hésite pas à conclure (p. 165) : « Pendant tout le moyen âge les médecins de l'Europe n'ont pas créé un seul traité d'ophtalmologie comparable à ceux des oculistes arabes. Il faut descendre jusqu'au début du dix-huitième siècle pour rencontrer, enfin, dans les ouvrages des SAINT-YVES, MAITRE-JAN, BRISSEAU, etc., un progrès notable laissant derrière lui les productions des Arabes ».

Le nouveau traité que nous devons à son érudition est beaucoup moins important que celui de ḤUNAIN IBN ISḤĀQ. Il ne contient rien qui soit essentiellement neuf ; il est postérieur non seulement au IX^e siècle

mais au X^e^ et peut-être même au XI^e^, car son époque est incertaine. La date « XII^e^ siècle » incluse dans le titre, est possible et même plausible, mais l'auteur même n'ose pas la revendiquer dans son introduction. Il est donc regrettable, soit dit en passant, que cette date ait été insérée dans le titre, car la plupart des lecteurs l'accepteront avec plus de confiance qu'elle ne le mérite.

Il ne faut pas confondre (comme je l'ai malheureusement fait dans mon *Introduction* 2, 424) l'auteur de ce traité, l'oculiste MUḤAMMAD IBN QASSŪM IBN ASLAM AL-GHĀFIQĪ avec l'herbaliste ABŪ JA'FAR AḤMAD IBN MUḤAMMAD AL-GHĀFIQĪ (1). Tous deux étaient fort probablement originaires de AL-GHĀFIQ, près de Cordoue, mais on ne peut affirmer qu'ils étaient contemporains ou parents. Le second est mort vers 1165, mais nous n'avons aucun point de repère pour l'âge du premier, sinon qu'il est postérieur à AVICENNE (mort en 1037), l'auteur le plus récent cité par lui. Il se peut qu'il ait vécu au XII^e^ siècle, mais il pourrait tout aussi bien appartenir à la fin du XI^e^, ou au XIII^e^. Il serait plus difficile toutefois de le placer après le XIII^e^ siècle, parce que dans ce cas son livre contiendrait quelque mention des grands oculistes égyptiens ou syriens de ce siècle.

Son livre est un traité général de médecine conduisant à l'oculistique. Il est divisé comme suit (je cite son propre texte tel que MEYERHOF nous l'a traduit, p. 16) :

« *Traité I :* J'y explique les recommandations d'HIPPOCRATE, la noblesse de notre art, les éléments, les différences entre eux, et le tempérament naturel et accidentel de l'œil. *Traité II :* J'y explique la configuration de la tête, les organes de l'œil, les artères, les veines, la description de l'œil, les muscles, l'esprit psychique, et les facultés naturelles. *Traité III :* J'y explique l'air environnant notre corps, le mouvement et le repos, les aliments et les boissons, le sommeil et la veille, les excrétions et la rétention, et les accidents psychiques. *Traité IV :* J'y explique les conditions contre nature, c'est-à-dire, les maladies, leurs genres et espèces, la description des maladies organiques, la solution de la continuité, les causes morbifiques, les maladies [des parties] homogènes du [corps], les causes des maladies organiques, les accidents suivant les maladies, les genres de [ces] accidents, les accidents qui affectent le sens de la vision, la qualité de la jouissance et de la douleur. Ensuite les accidents affectant le mouvement volontaire, les accidents résultant de la nature ou de la maladie ou des conditions à la fois naturelles et morbides, les accidents qui affectent la digestion et ceux qui par là affectent les conditions de l'œil. *Traité V :* J'y discute de la classification et des maladies et de leur traitement, les collyres secs *(akhāl)* et en pâte *(chiyāfāt)*, les poudres *(dharoūrāt)*, les sternutatoires *(sa'oūtāt)*, les hiéras *(ayāridjāt)*, les tryphéras *(itrifālāt)*, les décoctions, boissons, pommades *(marāhim)* et huiles *(adhān)*. [*Traité VI :* J'y discute du traitement de l'œil.] »

(1) MEYERHOF et SOBHY s'occupent de publier en arabe et anglais son traité des simples, abrégé par BARHEBRAEUS. Le premier fascicule de cette édition a paru au Caire en 1932 (*Isis* 20, 454-7).

MEYERHOF s'est borné à traduire quelques généralités du début, puis tout ce qui concerne l'oculistique, sauf la fin et la partie anatomique déjà incluse dans les *Trois traités d'anatomie arabe* édités et traduits par P. DE KONING (Leide, 1903). Il nous donne le quatrième chapitre du sixième traité « Sur les maladies oculaires des enfants », puis le cinquième chapitre « La discussion des maladies de l'œil et de leur traitement ». Ce dernier constitue la partie principale du présent ouvrage (p. 22-158). Cependant MEYERHOF ne l'a pas traduit en entier, mais seulement les sections 1 à 73. Tel quel ce cinquième chapitre n'est guère une nouveauté, car il est largement tiré du *Tadhkirat al-kaḥḥālīn* (Mémorial des oculistes) de 'ALĪ IBN 'ĪSĀ (2) qui n'a pas encore été imprimé en arabe, mais dont P. PANSIER a publié une traduction latine en 1903 et J. LIPPERT, une traduction allemande en 1904. Pour ce qui concerne la fin du chapitre MEYERHOF nous donne simplement les titres des sections (74 à 95), car celles-ci ne sont qu'une copie du *Tadhkirat* d'ALĪ IBN 'ĪSĀ et sont consacrées aux maladies internes de l'œil « dont les Arabes, ainsi que tous les oculistes jusqu'à l'époque de l'ophtalmoscope, ne savaient rien. Ces sections ne contiennent donc que des spéculations théoriques et scholastiques ». (p. 157).

L'ouvrage contient des dessins d'instruments de chirurgie tirés du manuscrit arabe (voir aussi le facsimile, p. 8), et est suivi d'un précieux glossaire et de « Remarques sur les collyres en orient dans l'antiquité et au moyen âge ».

Cet appendice nous prouve que l'oculistique arabe a emprunté quelques éléments aux traditions purement égyptiennes. L'usage de collyres en pâte était immémorial en Egypte, et divers noms de remèdes ont été empruntés à la langue égyptienne par les Grecs, les Arabes et les Latins.

« C'est le nom égyptien de l'antimoine *(mesdemet)* qui a donné lieu à la formation des noms grecs et latins de cette substance : en grec *stimmi*, en latin *stibium*, en arabe *ithmid* ou *athmoud*, transcrit *antimonium* dans les traductions barbaro-latines du moyen âge. Il y a d'autres remèdes dont les noms ont passé de la langue égyptienne dans la langue grecque, comme le ricin *(kiki)*, le vitriol *(misy)*, le sucre de plomb *(sory)*, etc. » (p. 159).

Il ne faut pas oublier cependant que l'oculistique arabe nous est venue tout d'abord de Mésopotamie et de Perse, que les auteurs des premiers traités arabes YŪḤANNĀ IBN MĀSAWAIH, ḤUNAIN IBN ISḤĀQ, étaient des chrétiens de Baghdād. Quand les Égyptiens se sont mis à la besogne, ils ont pu faire des additions à la science orientale, par exemple, ces fameux collyres que leurs lointains ancêtres leur avaient transmis, mais l'essentiel était fait. Cet essentiel était en partie emprunté à la science

(2) 'ALĪ IBN 'ĪSĀ vivait à Baghdād au début du XI[e] siècle (*Intr.* 1, 731).

grecque, car ḤUNAIN IBN ʾISḤĀQ avait traduit en arabe tous les passages de GALIEN, d'ORIBASE et de PAUL D'EGINE concernant l'œil, mais il est remarquable cependant qu'il n'y ait point d'ouvrages grecs spécialement consacrés à l'oculistique (3). A ce point de vue on peut dire que le traité de ḤUNAIN est le plus ancien traité existant, l'ancêtre de tous les traités ophtalmologiques de l'occident. GEORGE SARTON.

Harcourt Brown.—*Scientific Organizations in seventeenth Century France* (1620-1680). XXII+306 p. (History of Science Society. Publications, New Series nº 5). Baltimore, WILLIAMS & WILKINS, 1934.

L'auteur n'a pas fait une étude systématique et exhaustive des réunions, « conférences », assemblées ou sociétés qui poursuivaient au XVII^e siècle en France des buts scientifiques; il s'est borné à choisir quelques-unes des plus importantes et intéressantes d'entre elles durant une période de soixante ans (1). Ses recherches patientes jettent un jour assez nouveau sur les figures relativement obscures jusqu'à présent d'AUZOUT, PETIT, THEVENOT, JUSTEL, BOULLIAU, etc. Il publie une bonne moisson d'inédits, en général d'un intérêt secondaire, et le peu de renseignements qu'il apporte sur des questions essentielles montre tout ce qu'il est permis d'espérer de la publication (actuellement en préparation) du *diary* de HOOKE. Notons dans le dernier chapitre, le meilleur nous semble-t-il, d'ingénieuses considérations sur l'affaiblissement du mouvement scientifique en France à la fin du siècle.

Il y a une bibliographie (les références manquent souvent de précision). L'index est malheureusement très incomplet, ce qui diminue singulièrement l'utilité du livre.

Après ce bon début (le style est agréable et clair), nous sommes en droit d'attendre de Mr. BROWN des contributions intéressant plus directement l'histoire de la pensée scientifique. Pourquoi ne nous donnerait-il

(3) Le traité de DÉMOSTHÈNE PHILALÈTHE est perdu, mais il existait encore à l'époque de ḤUNAIN. Le principal traité grec est celui d'AËTIOS D'AMIDA, mais ce n'est pas un traité indépendant, simplement un livre de son encyclopédie médicale (*Introd.*, 1, 260, 434).

(1) Voici d'ailleurs les titres des 12 chapitres de l'ouvrage : 1. PEIRESC and the Cabinet of the Brothers DUPUY; 2. RENAUDOT and MERSENNE; 3. MERSENNE and England; 4. The MONTMOR Academy begins; 5. The MONTMOR Academy and England; 6. The End of the MONTMOR Academy; 7. La Compagnie des Sciences et des Arts; 8. The Conferences of HENRY JUSTEL; 9. Science and the Press : the *Journal des Savants* and the *Philosophical Transactions;* 10. The Academies of the Provinces; 11. The Academy of the Abbé BOURDELOT; 12. Fluctuat nec mergitur.

pas (je cite au hasard) un MARIOTTE, un PAPIN, un ROHAULT, un VARIGNON, un BARRÈME, un HÉRIGONE ? J. PELSENEER.

Harry Austryn Wolfson.—*The philosophy of* SPINOZA : Unfolding the latent processes in his reasoning. 2 vols. Cambridge, Mass., Harvard University Press, 1934 ($ 7.50).

One would never guess from the title of this book what unsuspected riches it contains. The philosophy of SPINOZA is only the focus for a flood of light thrown upon mediaeval philosophy, Jewish and Christian, and upon ARISTOTLE. It is not less an aid in the understanding of mediaeval philosophy than in the thought of SPINOZA, for according to Mr. WOLFSON, an adequate conception of SPINOZA's reasoning can be gathered only by a close scrutiny of the mediaeval furniture which so largely filled the mind of this philosopher. Mediaeval philosophy was written in Arabic, Hebrew, and Latin, but these " three philosophic literatures were in fact one philosophy expressed in different languages, translatable almost literally into one another." (I, 10). The abundance of mediaeval quotations bears out this statement to the full. It was, however, predominantly in the Hebrew version that SPINOZA pondered his problems and this claim, too, is fully substantiated by the book. Where others have merely affirmed the influence upon SPINOZA of Hebrew philosophers, Mr. WOLFSON has concretely demonstrated this out of his exhaustive knowledge. By way of their general interest in SPINOZA philosophical students will now be in a position to acquire familiarity with mediaeval Jewish philosophy, which is only now beginning to be noticed a little more generally, thanks to the splendid writing and teaching of Professor WOLFSON. It is fortunate that Jewish philosophy has in Mr. WOLFSON an expositor whose erudition in mediaeval philosophy extends as far as any mind can reach in all three literatures. It is consequently to be expected that we have here more than a specialized treatise. The discerning reader will often come upon passages giving swift insight into some phase of the mediaeval philosophic mentality. He will be fascinated by passages which compactly summarize the history of some idea, such as the account of the adventures of the idea of self-preservation (II, 195 ff.), or the early vicissitudes of the notions of duration and time (I, 336), or the general statement of the mediaeval world view (I, 219-221). He will be impressed more than ever with the centrality of ARISTOTLE for mediaeval thought by the lucid and explicit manner in which Mr. WOLFSON makes this evident, and he will grant Mr. WOLFSON's contention that the influence of ARISTOTLE on SPINOZA has been underestimated. He will learn an unforgettable lesson in the historical treatment of ideas, in tracing their filiations.

In short, Mr. WOLFSON is not only expounding the philosophy of SPINOZA: he is stating and illustrating a method of historical research as well. His book is the philosophic counterpart to Professor LOWES' recent work on COLERIDGE, "The Road to Xanadu." Each book reveals the meaning, literary and imaginative in the one case and philosophic in the other, of the words used by their authors when these words are interpreted as they were meant in the contexts where they were met with in the course of the author's reading and study. Mr. WOLFSON maintains that the *Ethics* merely states conclusions, and that each word must be carefully scrutinized so that allusions to other views latent in the use of that particuliar word may be discovered and the *full* meaning of the word realized. As a result of this theory it is easy to see why Mr. WOLFSON's commentary contains such a wealth of material in mediaeval philosophy. The indispensable prelude to the understanding of any philosopher, Mr. WOLFSON affirms, "is the determination by the method of historical criticism of what the philosopher meant by what he said, how he came to say what he said, and why he said it in the manner in which he happened to say it... The task before us, then, is to *reconstruct* the process of SPINOZA's reasoning in all its dialectical niceties and in all its *fulness of detail* so that it will lead us to a thorough understanding of the statements which confront us in the *Ethics*." (I, vii, 7. Italics mine). To make this reconstruction, Mr. WOLFSON goes to mediaeval, ancient, or contemporary philosophy, determining in each case whether the influences were direct or indirect, whether SPINOZA is using a unique source or uttering a philosophic commonplace of the time, or whether the source is entirely unknown. The aim of Mr. WOLFSON is to present a philosophy of SPINOZA as a coherent, systematic, *fully explicit* whole, and this explicitness cannot be gained from inspection and logical analysis of the *Ethics*. Sources must be ferretted out. For instance, the intricate implications of SPINOZA's second proof of the existence of God from the idea of "necessary existence" involves a set of ideas on "possible" and "necessary" which could only be known from mediaeval sources (I, 185). And Mr. WOLFSON, like the sophisticated artist, is highly conscious of his own technique. Upon reading the book one discovers that his statement of method in the first chapter, "Behind the Geometrical Method," is accurate and faithful to his actual procedure.

It is only after some such study as this that one can judge with any authority what is new in the philosophy of SPINOZA. Mr. WOLFSON's conclusion is that the originality of SPINOZA did not so much consist in the promulgation of new ideas as in "acts of daring," as Mr. WOLFSON puts it. SPINOZA was courageous enough to face all the logical consequences inherent in the theological and metaphysical ideas which were

current in Europe since PLOTINUS supplied the complement to the philosophic structure laid down by ARISTOTLE. This courageous facing of issues despite the condemnation of the good people of his time is only the sort of thing which any man must do if he persists in giving voice to ideas destined to dominate the future. SPINOZA gave unfaltering adherence to " the principle of the unity of nature, which in its double aspect meant the homogeneity of the material of which it is constituted and the uniformity of the laws by which it is dominated." (II, 331). The elements of this final view had been expressed by others, but no one had yet expressed all of them with such cogency and logical courage. Affirmation of the materiality of God in addition to his intellectuality, denial of all arbitrary or spontaneous elements in the actions of God and man, affirmation of the inseparability of the human body and soul, despoiling God of both personality and purpose—to have asserted all these doctrines at once was to have given first expression to the outlook of a later time. Like most first-rate thinkers, SPINOZA was Janus-faced, looking out both upon the past and the future : he was, as Mr. WOLFSON has said, " the last of the mediaevals and the first of the moderns." SPINOZA was not throughout entirely aware of the radical departure he had made from traditional theology. " His God-intoxication," writes Mr. WOLFSON, " was really nothing but a hangover from an earlier religious jag." (II, 348). But the logical integrity of SPINOZA has done its damage, and his influence towards a naturalistic *Weltanschauung* has been very great.

This book has the necessary limitations of any sound historical work in that it does not attempt to examine all the alternative interpretations of the philosophy. " We have refrained from entering upon an examination and comparison or criticism of the various extant interpretations of SPINOZA—a subject which, if dealt with at all, is deserving of a study by itself." (I, viii). Such differences of opinion on the meaning of a philosophy will always exist, however, and it is not to be expected that Mr. WOLFSON has said the last word on SPINOZA, as indeed no one can do when a primary philosopher is concerned. All that was possible in this reconstruction was to make out the most justifiably consistent case for SPINOZA. The method also precludes stating and treating the problems of SPINOZA in the terms of, and with reference to, the problems now agitating the philosophic atmosphere. It is doubtful if the book could be contemporary in its orientation and at the same time remain an adequate, detached historical study. Yet we should like to ask Mr. WOLFSON many systematic questions about his denial of pantheism in SPINOZA, about his subjective interpretation of the attributes, and about the parallelism of thought and extension. But this should not

embarrass Mr. WOLFSON, since only God could answer them satisfactorily.

I cannot begin to discuss or even mention the forceful interpretations of many Spinozistic, and indeed universal, problems such as Mr. WOLFSON's interesting thesis that the ontological proof is really an analytic syllogism in which the existence of God is known intuitively, but expressed in analytic terms by a syllogism. In a lucid and fluid style Mr. WOLFSON weaves in and out of complicated arguments with the greatest apparent ease and clarity. The book is written in a spirited fashion and makes absorbing reading. The author is extraordinarily considerate of his readers in providing detailed indexes of references of terms in Latin, Hebrew, and Arabic, and of subject matter. This is a book to evoke enthusiasm. To the man interested in the history of philosophy and in SPINOZA, here is God's plenty.

Harvard University. LOUIS HARAP.
Cambridge, Mass.

Adolf Meyer.—*Ideen und Ideale der biologischen Erkenntnis* (Bios, Band I). XIII+202 p., Leipzig, BARTH, 1934.

Im vorliegenden Buche, das den ersten Band einer neuen Sammlung, " BIOS, Abhandlungen zur theoretischen Biologie und ihrer Geschichte, sowie zur Philosophie der organischen Naturwissenschaften," darstellt, bespricht ADOLF MEYER " Ideen und Ideale der Biologischen Erkenntnis." Das Buch stellt eine Ausarbeitung von Vorträgen und Vorlesungen dar, die der Verfasser bei einem dreijährigen Aufenthalt an südamerikanischen Universitäten gehalten hat. Es ist darin der Versuch gemacht, eine wirklich leistungsfähige, rein biologische Theorie des Organischen zu gewinnen. Nach Ansicht des Verfassers kann eine solche " nicht in den Niederungen der Forschung, im Kleben an ihren Gegenständen und Methoden, gefunden werden, sondern man kann zu ihr nur gelangen, wenn man nach den letzten universellen Ideen und noch mehr nach den oft sehr geheimen Idealen sucht, die alle echte und autonome Forschung letzten Endes leiten und begeistern." Dadurch bekommt das Buch die Aufgabe, ein autonomes Erkenntnisideal für die Biologie zu formulieren und der " theoretisch überall stagnierenden biologischen Spezialforschung neue fruchtbare Anregungen und Problemstellungen zu vermitteln, die längst bekannte Dinge in neuem Licht erstrahlen und bisher unbekannte Zusammenhänge aufleuchten lassen, die somit von uralten Dingen eine gänzlich neue Wissenschaft lehren." Es wird versucht, die Konsequenzen der neuen Idee des " Holismus " für im Vordergrund des Interesses stehende biologische Disziplinen und Probleme so weit zu entwickeln, " dass die Spezialforscher unmittelbar Anregung für ihre eigene Arbeit empfangen und auf neuen Grundlagen

neue experimentell angreifbare Probleme formulieren können." Der erste Abschnitt des Buches bringt einen historischen Überblick über die zeitliche Entwicklung der verschiedenen biologischen Probleme vom Altertum bis in unsere Zeit. Die Darstellung ist sehr interessant, da sie eine schöne Entwicklung von der statischen Auffassung der Lebenserscheinungen zu der dynamischen gibt, die schliesslich in der in letzter Zeit von J. B. S. HALDANE ausgesprochenen Anschauung des Organizismus oder Holismus gipfelt, nach welcher man möglicherweise die physikalischen Prinzipien und Gesetze aus den biologischen ableiten könnte. Danach wäre dann die sogenannte physikalische Wirklichkeit nichts anderes, als eine Art von modellmässiger Vereinfachung der organischen. Im zweiten Abschnitt wird die biologische und physikalische Gesetzlichkeit besprochen. Hierbei wird der Versuch gemacht, die Biologie von fremden Erkenntnisidealen zu befreien und auf eigene Füsse zu stellen. Die Grundfrage hierbei ist, ob die biologischen Gesetze zu den physikalischen in irgend einem bestimmten Ableitungsverhältnis stehen. Der Verfasser kommt hierbei zu dem Schluss, dass im Vergleich mit den physikalischen Gesetzen, die Gesetze, Prinzipien und Axiome der Biologie die universaleren und die allgemein gültigeren sind, und dass es daher die letzte Aufgabe der theoretischen Biologie ist, ihre Prinzipien und Gesetze in solche Form zu bringen, dass die physikalischen Gesetze durch simplifizierende Ableitung aus ihnen deduziert werden können. Ferner entwirft der Verfasser eine neue Theorie des Organischen, da es bisher durch die Bemühungen von DRIESCH und v. UEXKÜLL nicht gelungen ist, auf axiomatischer Grundlage eine solche zu entwickeln. Besonders gilt dies für die Lehre der spezifischen organismischen Energien und Entelechien, wonach das physikalische Prinzip von der Erhaltung der Energie dem organismischen Prinzip der Erhaltung der spezifischen Energie und das physikalische Entropieprinzip dem organismischen Entelechieprinzip entspricht. Verschiedene Diagramme zeigen die räumlichen und zeitlichen Zusammenhänge der Realwissenschaften, besonders der Biologie. Die Theorien der organismischen Parasitose, Symbiose und Synthese werden entwickelt, und mit zahlreichen Beispielen aus der Stammesgeschichte der Organismen, Organbildung, Embryologie, Entwicklungsmechanik, Befruchtung und Fortpflanzung und schliesslich dem Chromosomenmechanismus illustriert. Im nächsten Kapitel wird der historische Gedanke in der Biologie behandelt. Es werden Gedanken darüber ausgesprochen, wie die Phylogenie als historische Wissenschaft behandelt werden kann. Diesem Kapitel folgen Skizzen zur Erkenntnistheorie der biologischen Wissenschaften. Darin werden zunächst die HEISENBERGsche Unsicherheitsrelation und die Stufenfolge des psychophysischen Problems besprochen, dann die Ontologie des Organischen,

die biologische Bedeutung der kausalen Erkenntnis und schliesslich das Kontingenzproblem. Alle Gedankengänge sind so miteinander verbunden, dass eine neue, Holismus genannte, rein biologische Theorie der organischen Systeme entsteht, deren Konsequenzen für alle wichtigen Gebiete der Biologie dargetan werden. Der Verfasser wollte jedoch mit diesem Buche " noch nicht eine vollendete " Theoretische Biologie " selbst vorlegen, an die man schon die von der theoretischen Physik gewohnten Masstäbe anlegen könnte," und so soll das Buch als Wegweiser zu dem Endziel einer wirklichen theoretischen Biologie dienen.

(*Harvard University.*) ERNST WOLF.

Lewis Mumford.—*Technics and Civilization.* XI+495 p. HARCOURT, BRACE and Co., New York, 1934. (Price $4.50).

" Our cannon shall be bent against the brows of this resisting town " is a threat put into the mouth of King PHILIP by SHAKESPEARE in his tragedy of King JOHN. To one who reads this play with a radio at his hand and the hum of an aeroplane in his ears, it is a distinct shock to realize that SHAKESPEARE has here been guilty of an anachronism by assigning cannon to a period removed only seven centuries from our own. Or one may perhaps fear that BULWER LYTTON in the *Last of the Barons* indulged in exaggeration when he inflicted so many miseries upon ADAM WARNER, the philosopher of his fancy who only sought to perfect an engine forecast in the works of ROGER BACON. But thus are we made to realize what a thin veneer of time covers the unmechanized past of our ancestors.

The book under review was written as an orientation for those who would understand the evolution of the machine and its meaning in the development of civilization. " During the last thousand years the material basis and the cultural forms of Western Civilization have been profoundly modified by the development of the machine. How did this come about? Where did it take place? What were the chief motives that encouraged this radical transformation of the environment and the routine of life: what were the ends in view: what were the means and methods: what unexpected values have arisen in the process? These are some of the questions that the present study seeks to answer."

Admitting that the roots of our mechanical civilization are to be found in earlier cultures, especially those of the Greeks and Romans, the author places the origin from which our present schema of life has been continuously evolved at approximately the eleventh century. He divides this evolution into three phases, the *eotechnic*, the *paleotechnic*, and the *neotechnic*. The first of these ran from 1000 to 1750; the second, overlapping both the preceding and the later phase, began about 1700, reached

its high point about 1870, and merged with the neotechnic period at the beginning of the present century. " Speaking in terms of power and characteristic materials," says the author, " the eotechnic phase is a water-and-wood complex, the paleotechnic phase is a coal-and-iron complex, and the neotechnic phase is an electricity-and-alloy complex."

The author finds much to praise in the life and manners of the first phase, but he arraigns with just savageness the industrialism of the second phase. " With respect to human culture as a whole, the eotechnic period, though politically a checkered one, and in its later moments characterized by a deepening degredation of the industrial worker, was one of the most brilliant periods in history." We contrast this and similar statements with the section headings of his chapter on the paleotechnic period : The New Barbarism, Carboniferous Capitalism, Blood and Iron, the Destruction of Environment, the Degredation of the Worker, the Starvation of Life. He bitterly arraigns the introduction of slum and factory environment which replaced the pastoral environment of the earlier period. " Add to the lack of light a lack of color; except for the advertisements on the boardings, the prevailing tones were dingy ones : ... The rhythm of movement disappeared; within the factory the quick staccato of the machine displaced the organic rhythms, measured in song, that characterized the old workshop, as BÜCHER has pointed out : while the dejected and the outcast shuffled along the streets in Cities of Dreadful Night."

The author epitomized this era in the following words : " The state of paleotechnic society may be described, ideally, as one of wardom. Its typical organs, from mine to factory, from blast furnace to slum, from slum to battlefield, were at the service of death. Competition : struggle for existence : domination and submission : extinction."

The author, however, finds some solace in the fact that the sordidness of the paleotechnic period is one of transition. The roots of modern science and modern engineering were there. " But the truly significant part of the paleotechnic phase lay not in what it produced but in what it led to : it was a period of transition, a busy, congested, rubbish-strewn avenue between the eotechnic and the neotechnic economies."

The author finds a brighter picture in modern society. Here at last science begins to make its methods felt. The carefully tested principles of the man of science are contrasted with those of the leaders of industry of the preceding era who " were for the most part empirics : boasting that they were ' practical ' men they prided themselves on their technical ignorance and naïvety." A point too little appreciated by a public which lavishes fulsome praise upon popular inventors while it ignores and often treats with some suspicion the scientist is emphasized by

the author who says: "In the neotechnic phase, the main initiative comes, not from the ingenious inventor, but from the scientist who establishes the general law: the invention is a derived product." He calls attention to the fact that the telegraph was an inevitable consequence of the work of HENRY, and the radio, of the work of MAXWELL and HERTZ. To MORSE and MARCONI, without, let it be said, any disparagement of their achievements, goes popular acclaim rather than to those scientists who preceded them. Millions on whom the name of GIBBS registers no response have heard of EDISON. One seldom sees a more accurate statement of the aims and hopes of science than are recorded in this book.

The author, without blindness toward the dangers and the difficulties of the path, sees society moving toward a much greater amelioration which may ultimately approximate a Utopia based upon an economy of plenty. Society must perfect a regimentation of the benefits of the machine and learn new ways for the distribution of its goods. Just how this is to be accomplished, however, is not clearly shown. One notes with some surprise that a treatise of the value and scope of the present one, particularly where it devotes so much attention to social implications, fails to mention the name of V. PARETO. The problem of population growth is adequately treated, but the equally important problem of the statistical pattern which persists in the distribution of income, whether it be in dollars or material benefits, is submerged. One should like to know what the author believes regarding the law of PARETO, which affirms that the distribution of income in societies from the most primitive to the most complex inevitably follows the parabolic law, $\log y = a - 1.5 \log x$, where x is the size of income and y the number having that income or larger. Although this law has been tested statistically only for monetary income, it may reasonably be held to apply to other human values such as general intelligence, athletic ability, business capacities, etc. How can an economy of communism, based upon the energies of the machine, be established in a society in which one finds the fatal pattern enunciated by PARETO's law? One should like to know the answer to the questions: Is this law inevitable in human society? And if the answer is in the negative, then how is the pattern to be broken?

Enough has already been said to show that the author has an unusual facility in expression. "The machine came most slowly into agriculture, with its life-conserving, life-maintaining functions, while it prospered lustily precisely in those parts of the environment where the body was most infamously treated by custom: Namely, in the monastery, in the mine, on the battlefield." "Robbery is perhaps the oldest of labor-saving devices, and war vies with magic in its efforts to get something

for nothing." The book contains many such striking statements which constantly challenge the attention of the reader.

The volume concludes with an appendix which provides a list of important inventions since the tenth century and with a bibliography of 27 pages. One is pleased to note that the list of inventions includes such items as the discovery of logarithms, NEWTON's *Principia*, the first determination of the speed of light, etc. The book is attractively illustrated by a series of 16 plates done for the most part in a modernistic style.

Indiana University. H. T. DAVIS.

Collected Papers of Charles Sanders Peirce.—Volume IV: *The Simplest Mathematics.* Edited by CHARLES HARTSHORNE and PAUL WEISS. Harvard University Press, Cambridge, Mass., 1933. ($6.00.)

Inasmuch as the first three volumes of PEIRCE's *Papers* have been reviewed at considerable length in previous numbers of *Isis* (1), comment upon the fourth volume will be confined to a brief notice.

Under the title " The Simplest Mathematics," this volume assembles a variety of writings, mostly hitherto unpublished, in whose motley subject matter are represented algebraic and diagrammatic logic, the philosophy of logic, foundations of arithmetic, *Mengenlehre*, geometry and the theory of series, not to mention some scraps of epistemology and semantic and some laborious mathematical analyses of card tricks.

Of especial interest is a hitherto unpublished paper of about 1880 in which PEIRCE anticipates SHEFFER's (2) reduction of the primitive ideas of the propositional or Boolean algebra to a single binary operation. PEIRCE uses this device again in an unpublished writing of 1902. In the latter paper PEIRCE, like the Polish logicians of the present day, is concerned with the propositional calculus in its structural aspect as the simplest of all non-trivial calculi, that namely of two elements. He examines in detail the multiplicity and nature of the binary operations of that calculus, *i.e.* the binary truth-functions, and anticipates LEŚNIEWSKI (3) in the use of truth-function variables. He moves then to an analogous investigation of a calculus of three elements, but complicates the assignment by arguing that such a calculus must be at least a six-fold affair in view of the necessity of superimposing a true-false dichotomy; the now familiar device of replacing that dichotomy by a trichotomy, and identifying the three elements of his calculus with the three truth-values, apparently had not occurred to him.

(1) Vol. 19, 217-20, 220-29; vol. 22, 285-97.
(2) *Trans. Amer. Math. Soc.*, vol. 14, pp. 481-488 (1913).
(3) *Fundamenta Mathematica*, vol. 14, pp. 30 *sqq.* (1929).

The other material on exact logic has to do with logical graphs. A series of extensions and modifications of EULER's scheme of diagrams leads PEIRCE to an elaborate scheme of his own, designed for the expression of propositions involving any manner of complexity in point of relational structure, quantity and even modality. The system is intended rather for the analysis of logical structure than for the facilitation of inference; because of its cumbersomeness it is less suited to the latter purpose than is the algebraic form of logic. One questions the efficacy of PEIRCE's diagrams, however, in their analytical capacity as well. Their basic machinery is too complex to allow one much satisfaction in analyzing propositional structure into terms of that machinery. While it is not inconceivable that advances in the diagrammatic method might open possibilities of analysis superior to those afforded by the algebraic method, yet an examination of PEIRCE's product tends rather, apagogically as it were, to confirm one's faith in the algebraic approach.

The volume contains much on the foundations of arithmetic. PEIRCE takes ordinal arithmetic as more fundamental than cardinal, chiefly, it seems, because of the fact that fractions, although definable in no obvious way as multitudes, admit of natural generation as terms in an ordinally defined series. The development of the finite integers proceeds by means of the transitive relation *greater than*. For generating the infinite cardinals PEIRCE uses involution upon a finite base; the first term of the series is the denumerable infinite, and each later term is 2 with the preceding infinite number of the series as exponent. PEIRCE assumes that there are no infinite numbers intermediate in magnitude between consecutive terms of the series thus generated, and thus never raises the moot question of whether all the alephs, or indeed any beyond the first, are comprised among the terms of his power series. But despite this omission PEIRCE's treatment of infinite arithmetic and attendant speculations possess much more than historical interest.

In a somewhat philosophical vein PEIRCE turns from such considerations to a discussion of continuity, and points out the muddled character of much that is thought on this topic. His main theme is the non-existence, even ideally, of individual points save at breaches of continuity. Moving to the logically elusive notions of the infinitesimal, geometrical infinity and the geometrical absolute, he preaches realism as opposed to nominalism. His defense of the infinitesimal falls little short of branding the theory of limits a superstitious bit of over-caution.

Mention should be made finally of PEIRCE's formal definition and somewhat extended investigation of cyclic systems. He defines a cyclic system in effect as a couple (α,R) such that (i) every member of the class α has the relation R to some member of α, but (ii) no proper part

$\acute{a}$ of a fulfills (i). He studies such systems both formally and through illustrative problems in the form of card tricks. The development is not without interest, but, like much of PEIRCE's work, it abounds in complexities which could be untangled and diffuseness which could be compacted with prejudice neither to rigor on the one hand nor to perspicuity on the other.

The volume as a whole recommends itself to the logico-mathematical reader above its predecessors in the series. Its 600 pages contain a generous variety of good entertainment.

(*Harvard University*). W. V. QUINE.

David Eugène Smith and **Jekuthiel Ginsburg.** — *A History of Mathematics in America before 1900.* (The Carus Mathematical Monographs, no. 5). x+209 p. The Mathematical Association of America with the cooperation of The Open Court Publishing Company, Chicago, Illinois, 1934. (Price $2.00).

Interest in the history of scientific thought in American colonies is notable, particularly in medicine, chemistry, astronomy and mathematics. This small volume before us reminds us of the words of Sir WILLIAM DAMPIER, " That local history is of extreme importance towards a better understanding of a larger history of a subject." However, in the case of this book, we find it transcends more than sectional or local history, as it treats of one country and almost a complete period; nevertheless, it does aid in forming a part of the larger aspect of the history of mathematics.

There has lately come to the attention of scholars a most remarkable and seemingly inexhaustive source material in the form of manuscripts relating to the history of pioneer scientific efforts in the English colonies. These are to be found in the archives of the Royal Society of London. In addition to this manuscript material, the first seventy volumes of the Transactions of the Royal Society form the richest source material for early American thought. During the colonial period of our history in the United States, that is, from the founding of Jamestown, Virginia, in 1609, to the signing of the treaty of Paris in 1783, such colonists who were interested in any phenomena of nature or the physical aspect of the new land or the character of the fauna and the flora of the country, as well as the species of fossils, were in the habit of writing diaries and descriptive letters of their observations and conclusions. These communications, for the most part, were directed to the secretaries of the Royal Society or to the Astronomer Royal or other distinguished scholars at home. In the case of mathematics, however, we are not so fortunate in finding early evidence of speculation in this subject. The reason

for this is doubtlessly the nature of life in the new land which was not conducive to speculation in the realm of formal logic.

It affords a great deal of satisfaction to review a book written so ably by mathematical scholars who have themselves the prerequisite historical background for colonial studies, such as the joint authors of " A History of Mathematics in America before 1900." At the outset we must congratulate the authors on having placed before mathematicians and other scholars a small volume giving the synopsis of the mathematical progress in the United States from early colonial period to almost contemporary generations. In this volume Doctors SMITH and GINSBURG have, in addition, prepared the way for the future scholar who may wish to write an analytical study of the history of mathematics. Such a work was, in fact, prepared by the late Dr. FLORIAN CAJORI (1) in 1890, but this now needs considerable revision.

The subject matter in this small volume is dealt with in four convenient and concise chapters—but virtually grouped into two larger historical aspects, namely, the Colonial period and the Modern or Contemporary period. Chapter 1, treating of the 16th and 17th centuries is largely an introduction to the more important centuries which follow, namely the 18th and 19th centuries. In each of these periods the subject matter is given the same general treatment, showing that mathematical knowledge could not progress without the aid of colleges, universities, learned societies, text books, and periodicals. The importance of the life of the individual mathematician and his contribution to mathematics follows the same general treatment throughout the whole book, a brief statement of the very essential facts being given. To critically examine this work, it is necessary to call attention to several small and detailed omissions, presumably due to oversight. The principal error is the date of the founding of the American Philosophical Society, which has recently been established legally as 1727. It would seem, according to the latest researches of Dr. S. E. MORISON, professor of history at Harvard University, that BILLINGSLY's Elements of EUCLID (1st English Translation) was the first text book used at Harvard College and this by its first president, HENRY DUNSTER. It is interesting to note that this particular copy is now preserved in the rare book room of Yale University. In addition, we find that a copy of PETRUS RAMUS, *Arithmetica et Geometria*, 1627, may have been used also. This fact is deduced from a study made of a copy found in the library of the American Antiquarian Society, which is completely annotated by COTTON MATHER. We must also

(1) CAJORI, FLORIAN, *Teaching and History of Mathematics in the United States*. U. S. Bureau of Education, Circular of Information, no. 3, 1890. Wash., G.P.O. 1890.

call attention to the fact that in justice to MATHER, we should think of this colonial minister and scholar in nobler terms than an erudite bigot. He doubtlessly maintained strong religious doctrines but he also was singularly sincere and at the same time a vigorous soul, which qualities are indeed necessary to any leader who tries to guide a weak and scattered community, such as existed in his period. MATHER is now to be considered as having held more rational views on scientific subjects than he has heretofore been given credit. He also held to the view that science was a proper part of a well balanced curriculum in our colonial colleges.

While it is true that the Newtonian philosophy as embodied in the *Principia* was having an influential effect on the mathematical studies of the time, it is doubtful whether or not we can safely state that the study of " fluxions " was actually begun as early as 1719. Not until 1751 do we find in the theses at Harvard, algebraic expressions in the form of differentials to be solved by the method of fluxions.

It was generally supposed that JOHN QUINCY ADAMS, rather than JAMES MUNROE, was virtually responsible for establishing the national observatory. All through his public career his strong and enthusiastic determination in and out of Congress was to have this country possess the best astronomical observatories, thus becoming worthy of recognition in Europe. He earned for himself the title, " Father of the Lighthouses of the Sky." His public utterances at this time aided also in establishing the Harvard College Observatories at Cambridge and the Cincinnati Observatory in Cincinnati. In the year 1843 at the age of 76 years, QUINCY travelled from Boston to Cincinnati, first by train, second by canal and finally by stage and horseback, a journey of three weeks, at that time considered an arduous trip, to give the dedication address at the laying of the cornerstone of the Cincinnati Observatory.

Finally, the last chapter offers much food for thought. The manner in which the authors have condensed this most important period from 1875 to 1900 reveals their comprehensive grasp of the subject matter. The short life sketches throughout the book could not have been better, as the length of each is according to the importance of the man or woman as a teacher or scholar. No mathematician of importance seems to have been omitted.

We would respectfully call to the attention of the authors that on page 198 the problem of astronomy, particularly in reference to the colonial period, was primarily to find the longitude of a place and consequently the time and not the latitude, which was much easier. This problem of longitudes was of great concern to England who was then asserting her place on the seas.

In the last four sub-chapters of Chapter 4 (1) American dissertation, (2) General trend of mathematics in America 1872-1900, (3) Trend of important branches, and (4) Retrospect, the general direction of American mathematics is shown. American dissertations from the leading universities during the period under discussion, have come from the following institutions : Johns Hopkins University (1878-1900), Columbia University (1880-1900), Clark University (1889-1900), and the University of Chicago (1896-1900), giving a total of ninety mathematical theses prepared at this time and it is an interesting fact that approximately one third of those who received their doctorate became distinguished scholars and teachers. This fact, together with the great increase in subjects of research and published papers in mathematical periodicals, indicates a complete awakening and independence from European influence.

In conclusion, we wish to say that this book presents an excellent but very brief survey of mathematical progress in the United States and fulfills the terms of the notable gift to the Mathematical Association of America, as given in the following paragraph.

" The Carus Mathematical Monographs are an expression of the desire of Mrs. MARY HEGELER CARUS, and of her son, Dr. EDWARD H. CARUS, to contribute to the dissemination of mathematical knowledge by making accessible at nominal cost a series of expository presentations of the best thoughts and keenest researches in pure and applied mathematics. The publication of these monographs was made possible by a notable gift to the Mathematical Association of America by Mrs. CARUS as sole trustee of the EDWARD C. HEGELER Trust Fund. The expositions of mathematical subjects which the monographs will contain are to be set forth in a manner comprehensible not only to teachers and students specializing in mathematics, but also to scientific workers in other fields, and especially to the wide circle of thoughtful people who, having a moderate acquaintance with elementary mathematics, wish to extend their knowledge without prolonged and critical study of the mathematical journals and treatises. The scope of this series includes also historical and biographical monographs." (2)

(Library of Congress.) FREDERICK E. BRASCH.

(2) Facing title page of "Carus Mathematical Monographs."

Forty-first Critical Bibliography

of the
History and Philosophy of Science and of the History of Civilization

(*To April* 1934,—*with special reference to Greece and Rome*)

This forty-first Bibliography contains about 345 items of which 60 deal with Greece and Rome. They have been kindly contributed by the six following scholars belonging to three different countries :

C. W. ADAMS (Hertford, England)
R. C. ARCHIBALD (Providence, R.I.)
C. A. KOFOID (Berkeley, Cal.)
J. PELSENEER (Brussels)
A. POGO (Washington, D.C.)
G. SARTON (Cambridge, Mass.).

This Bibliography includes as usual a series of addenda and errata to SARTON's *Introduction to the History of Science*, vols. 1 and 2 (Baltimore and London, 1927 and 1931). Its purpose and methods have been explained in the preface to the thirty-eighth Critical Bibliography (*Isis* 20, 506-8).

I entreat the authors of relevant books and papers to send me copies of them *as promptly as possible* in order that their studies may be registered in this bibliography and eventually reviewed and discussed. By so doing they will not simply help me and every other historian of science but they will help themselves in the best manner for they will obtain for their work the most valuable publicity and its certain and final incorporation into the literature of the subject.

Harvard Library 185.
Cambridge, Mass.

GEORGE SARTON.
34.04.20

PART I

FUNDAMENTAL CLASSIFICATION (CENTURIAL)

IXth Century B.C.

Myres, J. L. The last book of the *Iliad*. Its place in the structure of the poem. *Journal of Hellenic Studies* 52, 264-96, 8 fig., 1932. ISIS

Sarton, George. The artificial fertilization of date-palms in the time of ASHUR-NASIR-PAL, B.C. 885-860. *Isis* 21, 8-13, 4 pl., 1934. ISIS

"The purpose of this note is to draw attention to facts which have long been known to Assyriologists but have not yet been integrated in the history of botany." "The artificial fertilization described by THEOPHRASTUS was (or seems to have been) illustrated as early as the first third of the ninth century, in the admirable bas-reliefs which adorned the royal palace of ASHUR-NASIR-PAL, King of Assyria from 885 to 860."

Vth Century

Baumann, E. D. Du médecin philosophe d'HIPPOCRATE. *Janus* 38, 25-32, 1934. ISIS

Sulzberger, Max-Raymond. La *Physique* d'EMPÉDOCLE. *Mélanges Bidez*, p. 913-15, Bruxelles, 1934. ISIS

IVth Century B.C. (second half)

Corte, Marcel De. Notes critiques sur le "De anima" d'ARISTOTE. *Revue des études grecques* 45, 163-94, 1932. ISIS

Voglianio, Achille. Autour du jardin d'EPICURE. *Mélanges Bidez*, 979-92, Bruxelles, 1934. ISIS

IIIrd Century B.C. (second half)

Hofmann, J. E. "Über die Annäherung von Quadratwurzeln bei ARCHIMEDES und HERON." *Deutsche Mathematiker-Ver., Jahresbericht* 43, 187-210, 1934. ISIS

Richly documented paper on a question much discussed. Quotation: "Damit ist bewiesen, dass die Archimedischen Wurzelnäherungen in der Kreisrechnung durchaus nicht als tastende Versuche erklärt werden müssen,

sondern als Frucht eines wohlerwogenen und ausnahmslos zur Anwendung gebrachten Kalküls aufgefasst werden können." Earlier publications in the Jahresbericht were by Z. CHAJOTH, "Heronische Näherungsbrüche," 42, 130-35, Dec. 1932; and by K. VOGEL, "Die Näherungswerte des ARCHIMEDES für $\sqrt{3}$", 41, 152-58, 1932. R. C. A.

Ist Century B.C. (whole and first half)

Bignone, Ettore. Osservazioni sul *Proemio* del libro secondo di LUCREZIO (*Lucr.* II v. 5-6 ; 18). *Mélanges Bidez*, p. 19-26, Bruxelles, 1934. ISIS

Carcopino, Jérôme. La naissance de JULES CÉSAR. *Mélanges Bidez*, p. 35-69, Bruxelles, 1934. ISIS

Drachmann, A. G. HERO's and pseudo-HERO's adjustable siphons. *Journal of Hellenic Studies* 52, 116-18, 5 fig., 1932. ISIS

Lippmann, Edmund O. von. Die Lehren der Atomistik bei LUCRETIUS. *Mélanges Bidez*, p. 585-601, Bruxelles, 1934. ISIS

IInd Century (whole and first half)

Dain, A. Les manuscrits des traités tactiques d'ARRIEN. *Mélanges Bidez*, p. 157-84, Bruxelles, 1934. ISIS

Mengeringhausen, J.; Mengeringhausen, M. Die Trajanstrasse an der unteren Donau. *Beiträge zur Geschichte der Technik und Industrie* 22, 136-37, 4 pl., 1933. ISIS

IInd Century (second half)

Puech, Henri-Charles. NUMÉNIUS D'APAMÉE et les théologies orientales au second siècle. *Mélanges Bidez*, p. 745-78, Bruxelles, 1934. ISIS

Walsh, Joseph. GALEN's writings and influences inspiring them. *Annals of medical history* 6, 1-30, 8 fig.; 143-49, 1934. ISIS

VIIth Century (whole and first half)

Pelliot, Paul. Trois termes des mémoires de HIUAN-TSANG. *Etudes à la mémoire de Raymonde Linossier*, 2, 423-31, Paris, LEROUX, 1932. ISIS

Apropos of HSÜAN TSANG (*Introduction* 1, 477).

XIth Century (whole and first half)

Ruska, Julius. Die Alchemie des AVICENNA. *Isis* 21, 14-51, 1934. ISIS

"Meine Studie hat ihren Zweck erfüllt, wenn sie den Leser überzeugt hat, dass die pseudonyme alchemistische Literatur des Mittelalters auf ihre Herkunft geprüft und nach Entstehungszeit und Quellen näher bestimmt werden muss, wenn die Geschichte der Alchemie nicht für alle Zeiten ein Haufwerk von Legenden bleiben soll. Eine dieser Legenden ist die Behauptung, dass AVICENNA zahlreiche alchemistische Schriften verfasst habe. Wir haben gesehen, dass in den echten Schriften des AVICENNA keine Stütze für die Annahme zu finden ist, dass sich seine schroffe Ablehnung der Alchemie später in ihr Gegenteil gewandelt hätte. Das Buch *De Anima*, das umfangreichste und originellste ihm zugeschriebene Werk, ist rund hundert Jahre nach seinem Tode in Spanien entstanden und trägt alle Kennzeichen seiner späten Entstehung und seines kompilatorischen Charakters. Der reiche und vielseitige Inhalt würde eine Neuausgabe rechtfertigen, die selbstverständlich nur nach gründlicher Prüfung aller noch vorhandenen Handschriften in Angriff genommen werden dürfte. Andere AVICENNA-Schriften sind noch jünger und haben lateinische Alchemisten zu Verfassern, die sich mit mehr oder weniger Geschick der zu ihrer Zeit verfügbaren Literatur bedient haben."

XIth Century (second half)

Waley, Arthur. An eleventh century correspondence. Translated and annotated. *Etudes à la mémoire de Raymonde Linossier*, 2, 531-62, Paris, LEROUX, 1932. ISIS

"The *Higashiyama Orai* is a correspondence in 43 letters and replies between an anonymous priest belonging to one of the temples on the Eastern Hills near Kyōto, and various of his parishionners. The latest date actually mentioned is, I think, 1091. The date of compilation was probably about 1100. At the end of the volume occurs (as mark of ownership?) the name of MINAMOTO NO ATSUTSUNE, who flourished about 1120. There is a supplement (57 letters and replies), apparently of about the same date. Each letter contains a question, in most cases concerning some point of Buddhist ritual, doctrine or iconography, and each question is answered in a detailed reply. A few questions concern points of medical and general knowledge, or practices and cults other than Buddhist." Examples: "Question 40. The idle years have slipped by. I am nearing the Shore. But while I wait, I have a body, that must needs be tended, a shifting cloud of life, that must be guarded. Friends tell me that I should study the art of wholesome living, and that by this means I can protect my body from decay. I therefore venture to address you... etc." "Question 38. The use of the waterpepper plant as a diet for disease of the eyes."

XIIIth Century (whole and first half)

Bartolomeus Anglicus. III. De proprietatibus rerum (Book seventh—on medicine). Translated and annotated with an introductory essay, by JAMES J. WALSH. *Medical life* 40, 453-96, 499-544, 547-602, facs., 1933. ISIS

Hartung, Edward F. Medical education in the 12th century. *Medical life* 41, 20-31, 1934. ISIS

"Two physicians, JOHN OF ST. GILES and GILBERTUS ANGLICUS, living contemporary lives at the end of the twelfth and the beginning of the thirteenth century, typify for England the passing of the old and birth of the new—the modern tradition of medicine—and we will use them in illustrating the education situation of the times."

Higger, Michael. YARḤI's commentary on *Kallah Rabbati*. *Jewish quarterly review* 24, 331-48, 1934. ISIS

A propos of ABRAHAM BEN NATHAN HA-YARḤI of Avignon, see *Introduction* 2, 555. G. S.

XIVth Century (whole and first half)

Grabmann, Martin. Die Aristoteleskommentare des SIMON VON FAVERSHAM († 1306). Handschriftliche Mitteilungen. 40 p. (*Sitzungsberichte d. Bayer. Akad. d. Wiss., Philos.-hist. Abtg.* H. 3, 1933). München, BECK, 1933. ISIS

Reviewed by FRANZ PELSTER, *DLZ* 5, 390-92, 1934.

Jenkins, Rhys. The Oliver. Iron making in the fourteenth century. The Newcomen Society, *Transactions* 12, 1931-1932, 9-14, 1933. ISIS

Scholz, Richard. MARSILIUS VON PADUA, Defensor pacis. Two fascicles. LXX+LXXIX+637 p. (*Fontes Juris Germanici Antiqui*). Hanover, HAHN, 1932, 1933. ISIS

Reviewed by W. P. REEVES, *American historical review* 39, 562, 1934.

Thompson, Daniel Varney, jr.; Hamilton, George Heard. An anonymous fourteenth century treatise *De arte illuminandi*. The technique of manuscript illumination. Translated from the Latin of Naples MS. XII.E.27. XIV+67 p. New Haven, Yale University Press, 1933. ISIS

XIVth Century (second half)

Chaucer, Geoffrey. The complete works. Edited by F. N. ROBINSON. XL+1133 p. (The Cambridge poets, student's edition). Oxford, Univ. Press, 1933. ISIS

Dölger, Franz. Die Abfassungszeit des Gedichtes des MELITENIOTES. *Auf die Enthaltsamkeit. Mélanges Bidez*, p. 315-30, Bruxelles, 1934.

Stapleton, H. E. Note on the historical and archaeological results of a tour in the districts of Māldah and Dināj pur, December 24th-31st, 1932. *Journal and Proceedings, Asiatic Society of Bengal*, 28, 151-71, 2 pl., 1933. ISIS

" The objects of this tour were : (A) to verify the site of the battle between SIKANDAR SHAH and his son GHIYĀSUDDĪN in which the former lost his life, c. 1390 A.D.; (B) to make further enquiries regarding the old Hindu city of Ekdālā before which two battles took place between FIRUZ SHAH of Dehli and (*a*) SHAMSUDDĪN ILYĀS SHAH of Bengal in the spring of 1353-4 A.D. and (*b*) SIKANDAR SHAH, ILYĀS SHAH's son, in the cold weather of 1358-9 A.D.; and (C) to enquire into the possibility of Karanji, a large *mauza* 15 miles to the W. S. W. of Dināj pur, being the native village of RĀJĀ GANESH who (with his son MAHENDRA) reigned over Bengal for a short period about 1416-19 A.D."

XVth Century (whole and first half)

Garosi, A. Alcuni documenti e rilievi sulla vita di UGO BENZI. (Atti della Società Italiana di Storia delle Scienze mediche e naturali, IV. Congresso Nazionale, Maggio 1933). *Rivista di storia delle scienze mediche* 24, 89-135, 2 pl., 1933. ISIS

Nicolae de Cusa De Docta ignorantia libri tres. Ediderunt ERNESTUS HOFFMAN et RAYMUNDUS KLIBANSKY. 4+XIX+179 p. (*Opera omnia iussu et auctoritate Academiae litterarum Heidelbergensis ad codicum fidem edita.* Vol. I.) Leipzig, MEINER, 1932. ISIS

Reviewed by S. KURLAND, *Isis* 21, 211-13, 1934.

XVth Century (second half)

Miller, William. The historians DOUKAS and PHRANTZES. *Journal of Hellenic Studies* 46, 63-71, 1926. ISIS

Nierenstein, M. ; Price, Frances M. The identity of the manuscript entitled " Mr. NORTONS worke, *de lapide ph'orum* " with the Ordinall of Alchimy. *Isis* 21, 52-56, 1 pl., 1934. ISIS

Thompson, Daniel V., Jr. The "Ricepte daffare piu colori" of AMBROGIO DI SER PIETRO da Siena. *Archeion* 15, 339-47, 1933. ISIS

From the holograph MS. dated 1462, preserved in Siena. Edition of the text. G. S.

XVIth Century (whole and first half)

D. — *Medical sciences*

Englert, Ludwig. Volksbewusstsein und Heimatgefühl bei PARACELSUS. *Deutsches Ärzteblatt*, Nr. 7, 12 p., 1933. ISIS

Mönch, Walter. Der Arzt SYMPHORIEN CHAMPIER (1471-1537) und seine geistesgeschichtliche Bedeutung für Frankreichs Frührenaissance. *Fortschritte der Medizin* 51, 14 p., October 1933. ISIS

XVIth Century (second half)

A. — *Mathematics*

Sarton, George. ADRIAAN VAN ROOMEN's commentary on AL-KHWĀRIZMĪ (c. 1598). *Query* no. 39. *Isis* 21, 209, 1934. ISIS

Sarton, George. JEAN TRENCHANT, French mathematician of the second half of the sixteenth century. *Query* no. 38. *Isis* 21, 207-09, 1934. ISIS

Author of a very popular arithmetic, first published in Lyon 1558. The author is practically unknown. G. S.

D. — *Medical sciences*

Edgar, Irving I. SHAKESPEARE's medical knowledge with particular reference to his delineation of madness. A preliminary survey of critical opinion. *Annals of Medical History* 6, 150-68, 1934. ISIS

Giordano, Davide. Nuovi documenti biografici su GIOVANNANDREA DALLA CROCE (1514-75). *Rivista di storia delle scienze mediche e naturali* 25, 1-9, 1934. ISIS

Head, Jerome R. Medical allusions in DON QUIXOTE. *Annals of Medical History* 6, 169-79, 1934. ISIS

XVIIth Century (whole and first half)

B. — *Physical sciences and technology*

Battistini, Mario. Italiani nel Belgio nel sec. XVII. ANTONIO NERI di Firenze (con una sua lettera terapeutica). *Rivista di storia delle scienze mediche e naturali* 25, 10-20, 1934. ISIS

ANTONIO NERI, author of *L'arte vetraria* (Florence 1612). G. S.

Iašnov, P. Die KEPLER-Handschriften und Reliquien der Sternwarte in Pulkowo. *Archives of the history of science and technology* 2, 199-216, Leningrad, Acad. of Science, 1934 (in Russian). ISIS

Zeitlin, E. Betriebstechnik in der russischen Manufaktur des 17. Jahrhunderts nach neuen Materialien. *Archives of the history of science and technology* 2, 179-98, Leningrad, Acad. of Science, 1934 (in Russian). ISIS

C. — *Natural sciences*

Klebs, Arnold C. Sur la date de la mort de FRANCESCO REDI. *Archeion* 15, 417, 1933. ISIS

It would seem that 1697 is the correct date (not 1696). G. S.

Solovjev, M. Dokumente der Brasilianischen Expedition von MORITZ VON NASSAU (1636-1643) im Zoologischen Institut der Akademie der Wissenschaften. *Archives of the history of science and technology* 2, 217-26, 6 fig., Leningrad, Acad. of Science 1934 (in Russian). ISIS

D. — *Medical sciences*

van Andel, M. A. De geneeskundige practijk der 17e eeuw naar titelprenten. *Bijdragen tot de geschiedenis der geneeskunde* 14, 23-26, 6 fig., 1934. ISIS

Brodier, L. De quelques lettres de CHARLES SPON. *Bull. de la soc. franç. d'hist. de la méd.* 27, 369-79, 1933. ISIS

Marconi, Enzo. Durata della gravidanza e determinazione del sesso in un manoscritto del 1600. *Atti della Società Italiana di storia delle scienze mediche e naturali*, 140-58, 1933. ISIS

"Verso la fine dell'anno 1631 POMPILIO TALIAFERRI (o TAGLIAFERRI) riceveva da persona certo molto influente l'incarico di stabilire la data del parto di una giovane sposa e determinare il sesso del nascituro. A tale incarico il TALIAFERRI adempiva compilando una relazione che si conserva manoscritta alla Biblioteca Estense di Modena e che può presentare un vivo interesse per lo studioso. Il manoscritto, assai accurato quanto a grafia consta di 37 pagine in 8°, non porta la firma dell'Autore nè indicazione precisa di data ed è intitolato : Discorso breve del parto umano di POMPILIO TALIAFERRI d'applicarsi al seguente caso." Analysis of the text. G. S.

Minkowski, Helmut. Einordnung, Wesen und Aufgaben der Heilkunst in dem philosophisch-naturwissenschaftlichen System des FRANCIS BACON. Zur Kenntnis der Beziehungen zwischen Medizin und Philosophie im 16. und 17. Jahrhundert. *Janus* 37, 325-53, 1933. ISIS

E. — *Alia*

Helmont, Jean Baptiste van (1577-1644). Numéro special consacré à lui dans *le Folklore brabançon*, 13e année, nos. 75-76. Bruxelles, décembre 1933 — février 1934. J. P. ISIS

Picard, E. Sur le " Discours de la méthode. " *La revue de France* 14, 55-66, 1934. ISIS

XVIIth Century (second half)

A. — *Mathematics*

Huygens, Christiaan (1629-95). Œuvres complètes publiées par la Société hollandaise des sciences. Tomes I-XVII. La Haye, NIJHOFF, 1888-1932 (à continuer). ISIS

Reviewed by GEORGE SARTON, *Isis* 21, 213-15, 1934.

Neville, E. H. WALLIS on the Trinity. *Query*. *Scripta mathematica* 2, 197, 1934. ISIS

Procissi, A. Il problema bernoulliano " De quadrisectione Trianguli Scaleni per duas normales rectas." *Periodico di matematiche* 14, 1-27, 1934.

ISIS

This problem was first discussed by JACQUES BERNOULLI (1654-1705) in *Acta Eruditorum*, 617-23, 1687; also in *Opera*, Geneva, 1744, 1, 328-35, and 2, 671. In his solution of the problem BERNOULLI is led to the deter-

mination of the intersection of a conic and a quartic curve. The problem was solved by L'HÔPITAL before 1704, the year of his death, in a posthumous work, *Traité analytique des sections coniques*, Paris, 1707, 400-07. As the result of correspondence in *L'Intermédiaire des mathématiciens*, 1-7, 1894-1900, questions 3 and 587 LORIA wrote the history of the problem, " Osservazioni sopra la storia di un problema pseudo-elementare," *Bibliotheca mathematica* 4, 48-51, 1903. LEIBNIZ's name occurs in this connection.

R. C. A.

C. — *Natural sciences*

Cowles, Thomas. Dr. HENRY POWER's poem on the microscope. *Isis* 21, 71-80, 1934. ISIS

Edition of Sloane MS. 1380 art. 16 (British Museum), dated 1661. With notes. G. S.

Dobell, Clifford. ANTONY VAN LEEUWENHOEK and his " Little Animals," being some account of the father of protozoology and bacteriology and his multifarious discoveries in these disciplines, collected, translated, and edited from his printed works, unpublished manuscripts and contemporary records. Published on the 300th anniversary of his birth. VIII + 435 p., 32 pl., 4 figs. New York, HARCOURT, BRACE, 1932. ISIS

Reviewed by C. A. KOFOID, *Isis* 21, 216-8, 1934.

Hiller, Johannes E. ANSELMUS BOETIUS DE BOODT als Wissenschaftler und Naturphilosoph. (Aus den Anfängen der mineralogischen Wissenschaft). *Archeion* 15, 348-68, 1 fig., 1933. ISIS

D. — *Medical sciences*

Beyerman, J. J. Eene overeenkomst op medisch gebied in 1680. *Bijdragen tot de geschiedenis der geneeskunde* 14, 27-28, 1934. ISIS

Larkey, Sanford V.; Suden, Linda Tum. JACKSON's English translation of BERENGARIUS OF CARPI's " Isagogae Breves," 1660 and 1664. *Isis* 21, 57-70, 5 fig., 1934. ISIS

" The enduring influence of the anatomical and surgical work of BERENGARIUS OF CARPI is shown by the translation into English of his ' Isagogae breves,' in 1660, one hundred and thirty-eight years after its first publication, and also by BOERHAAVE's edition of ' De Fractura cranii,' as late as 1715. The translation of the ' Isagogae ' was by HENRY JACKSON, a member of the Barber-Surgeons Company of London."

Pinkhof, H. De clinische urognostiek van een dokter uit de 17de eeuw.

Bijdragen tot de geschiedenis der geneeskunde 14, 54-56, 1934. ISIS

Notes on urological chapter of the *Ma'aseh Ṭobiah* which the author ascribes to TOBIAS KATZ (?). I cannot imagine to which book he refers unless it be the encyclopaedia called *Ma'aseh Ṭobiah* composed by the Polish physician TOBIAS COHN (1652-1729), first printed in Venice 1707. G. S.

Thorndike, Lynn. A glimpse of seventeenth century medicine. *Annals of Medical History*, 6, 124-27, 1934. ISIS

" A ' Defense of medicine ' by ANTONIO FRANCESCO BERTINI, professor of medicine, published at Lucca in 1699 offers an interesting view of conditions at the close of the seventeenth century and a retrospect over the preceding years. The work divides into two dialogues between DIEGO, a Spaniard, BRUNO, a Frenchman, and VINCISLAUS or WENZEL, a German."

XVIIIth **Century** (whole and first half)

A. — *Mathematics*

Baidaff, B. I. 150 años de la muerte de LEONARD EULER. *Boletín matemático* 6, 81-88, 1933. ISIS

Clarke, Frances M. On an anonymous essay on fluxions, published in 1741. *Scripta mathematica* 2, 155-60, 1934. ISIS

The author of " An explanation of fluxions in a short essay on the theory " was (Sir) FRANCIS BLAKE (1708-80). " BLAKE avoided many of the criticisms which BERKELEY leveled against contemporary authors, namely the use of infinitely small quantities, and so forth. The essay also contains a real improvement in the mode of deriving the fluxion of a ' product.' His ideas on fluxions were particularly clear for the period in which he wrote. Being clear, concise, accurate and well developed, the essay is a real contribution to the logic of fluxions during the eighteenth century." G. S.

De Vries, H. Historische Studien XIII. EULER. *Nieuw Tijdschrift voor Wiskunde* 21, 188-226, 1933-34. ISIS

Krilov, A. N. LEONARD EULER. Address... delivered at a solemn meeting of the Academy of Sciences 5 October 1933 (in Russian), 39 p., port., Leningrad, 1933. ISIS

Lorey, W. Eine Lücke in LEONHARD EULERS Beweis, dass eine ganze rationale Funktion einer Veränderlichen nicht nur Primzahlen darstellen kann. *Journ. f. d. reine u. angewandte Mathematik* 170, 129-32, 1933. ISIS

Many historical remarks with references. R. C. A.

Simons, Lao G. ISAAC GREENWOOD, first Hollis professor. *Scripta mathematica* 2, 117-24, 1934. ISIS

B. — *Physical sciences and technology*

Horn-d'Arturo, G. Chi fu il primo a parlare d'aberrazione? *Coelum* 3, 279, Bologna, 1933. ISIS

Interesting footnote to SARTON's paper on the Discovery of the aberration of light (*Isis* 16, 233-65, 1931). It is claimed that the first author to use the term aberration was not CLAIRAUT (1740) but EUSTACHIO MANFREDI : *De annuis inerrantium stellarum aberrationibus* (Bologna 1729). This was very early indeed. MANFREDI did not know the cause of these aberrations—and be it noted, he used that term in the plural. Hence he cannot be said to have been the first to speak of the aberration of light. CLAIRAUT spoke of the apparent aberration (sing.) of the stars. The difference is not simply grammatical. However MANFREDI realized that the same cause affected the aberrations of all the stars. G. S.

Johannsen, Otto. Die Geschichte des schwedischen Stahls. *Beiträge zur Geschichte der Technik und Industrie* 22, 122-26, 1933. ISIS

Kurzel-Runtscheiner, Erich. Das österreichische Salzwesen im künstlerischen Bild des 18. Jahrhunderts. *Beitrage zur Geschichte der Technik und Industrie* 22, 126-28, 1933. ISIS

Marian, Victor. DESCARTES Einfluss in Transsylvanien (Siebenbürgen) im XVIII. Jahrhundert. Ein Beispiel über den nachhaltigen Einfluss cartesianischer Physik. *Archeion* 15, 408-12, 1933. ISIS

" Es wurde hier gezeigt wie gross der Einfluss der cartesianischen Physik in Siebenbürgen im 18. Jahrhundert war. Obwohl einige siebenbürgische Gelehrte schon in der ersten Hälfte des 18. Jahrhunderts sich an die NEWTON'sche Physik lehnten, waren die meisten doch noch Anhänger DESCARTES, so dass die erste Physik im NEWTON'sche Sinne erst im Jahre 1774 veröffentlicht wurde."

Nordenmark, N. V. E. Sevensk astronomi och svenska astronomer 1700-1730. *Arkiv för Matematik, Astronomi och Fysik*, 24, 114 p., 2 pl., 1933. ISIS

Among other things this article surveys the life and work of PETRUS ELVIUS (1660-1718), NILS CELSIUS (1658-1724), ERIK BURMAN (1692-1729), all at Upsala; A. W. RIDDERMARCK (1651-1707), BONDE HUMERUS (1659-1727), and CONRAD QUENSEL (1676-1732) at Lund; and S. A. DIMBORG (?-1731) and SAMUEL KROOK (?-1716) at Dorpat. The portrait plates are of ELVIUS and QUENSEL. R. C. A.

C. — *Natural sciences*

Zirkle, Conway. Some forgotten records of hybridization and sex in plants, 1716-1739. *Journal of heredity* 23, 432-48, 3 port., Washington, D.C., 1932. ISIS

Reviewed by GEORGE SARTON, *Isis* 21, 218-20, 1934.

D. — *Medical sciences*

Barge, J. A. J. Het geneeskundig onderwijs aan de Leidsche Universiteit in de 18e eeuw. *Bijdragen tot de geschiedenis der geneeskunde* 14, 1-22, 19 fig., 1934. ISIS

Mauclaire, Dr. NICOLAS ANDRY (1658-1742), médecin Lyonnais (XVII[e] siècle). *Bull. de la soc. franç. d'hist. de la méd.* 27, 345-49, 1933. ISIS

Packard, Francis B. Dr. JOHN MITCHELL's account of the yellow fever in Virginia in 1741-42, written in 1748. *Annals of medical history* 6, 91-92, 1934. ISIS

XVIIIth Century (second half)

A. — *Mathematics*

Woyciechowsky, Josef v. PAUL SIPOS. Ein ungarischer Mathematiker des ausgehenden 18. Jahrhunderts über seine Ellipsenrektifikation mittels Kochleoide und seine alleinstehenden logarithmisch-trigonometrischen Tafeln mit unveröffentlichten Briefen von BODE und KÄSTNER. *Mitteilungen des mathematischen Seminars der Universität Debrecen* (Ungarn) VI. Heft. 124 p., 15 fig. Athenaeum, Budapest 1932 (in Hungarian with Germany summary). ISIS

"PAUL SIPOS (1759-1816) der erste ungarische Mathematiker dessen selbständige und auf der Höhe seiner Zeit stehende Abhandlung bekannt ist." Elaborate biography and discussion of his mathematical work (the German summary covers 8 p.), followed by the text of two German letters addressed to SIPOS by the astronomer J. E. BODE and A. G. KÄSTNER.

G. S.

B. — *Physical sciences and technology*

Claas, Wilhelm. Die Iserlohner Nähnadelfabrikation im Jahre 1788.

Beiträge zur Geschichte der Technik und Industrie 22, 128-29, 2 pl., 1933. ISIS

Claas, Wilhelm. JOHANN CASPAR RUMPE-ALTENA und sein Werk. *Beiträge zur Geschichte der Technik und Industrie* 22, 109-19, 2 pl., 1933. ISIS

Furber, Holden. FULTON and NAPOLEON in 1800: new light on the submarine Nautilus. *American historical review* 39, 489-91, 1934. ISIS

Radovskij, M. J. Quellenmaterial zum Studium der Tätigkeit I. P. KULIBINS. *Archives of the history of science and technology* 2, 227-46, Leningrad, Acad. of Science, 1934 (in Russian) ISIS

IVAN PETROVICH KULIBIN (d. 1818), Russian inventor.

Smith, David Eugene. DELAMBRE and SMITHSON. A translation and explanation of a letter in the library of Columbia University. 4 p., facs. Fulton, N. Y., Morrill Press, 1934. ISIS

Letter written by DELAMBRE in 1809 to ask the release of JAMES SMITHSON, prisoner of war in Hamburg. This SMITHSON was later the founder of the Smithsonian Institution. G. S.

Walker, W. Cameron. The beginnings of the scientific career of JOSEPH PRIESTLEY. *Isis* 21, 81-97, 4 pl., 1934. ISIS

Study based on the JOHN CANTON (1718-72) papers in the Library of the Royal Society. "They throw an interesting light upon PRIESTLEY's relations with some of his Contemporaries and particularly upon the sequence of events leading to his election to the Fellowship of the Royal Society and to the publication of his 'History and present state of electricity.' In these events no one played a more important part than JOHN CANTON." G. S.

C. — *Natural sciences*

Drewitt, F. Dawtrey. The life of EDWARD JENNER M. D., F.R.S., naturalist, and discoverer of vaccination. Second edition (enlarged). 151 p. London, LONGMANS, GREEN, (6/). ISIS

This work relates the story of JENNER's discovery that vaccination with cow-pox gave immunity against smallpox and of his success in introducing this vaccination in Great Britain and Europe and even into distant lands as a preventive of smallpox and a substitute for the all-too-often fatal inoculation with that disease. JENNER's relations with Dr. JOHN HUNTER and with the Royal Society are described, and his notes on the shocking behavior of the young cuckoo are quoted, together with the attacks upon his veracity which it excited, including the deferment in publication for a year by the Royal Society. The attacks upon JENNER by CREIGHTON and other opponents

of vaccination are reported. The Reports of the Royal Commissions on Vaccination of 1889, 1896, and 1930 are noted and current practice in Great Britain of vaccinating in one spot only on the arm before school age and once later is cited. The NORTHCOTE portrait and the PAGE engraving of JENNER are reproduced and a photograph of MARHSALL's bronze statue removed from Trafalgar Square to Kensington Gardens in 1862 is included. The first edition was published in 1931.

February 10, 1934. C. A. KOFOID.

Garboe, Axel. JOSEPH GOTTLIEB KOELREUTER ein Vorlaeufer MENDELS. *Archeion* 15, 385-94, 4 fig., 1933. ISIS

Schmid, Günther. Eine unbekannte mykologische Arbeit PERSOONS (1793), zugleich ein Beitrag zur Lebensgeschichte des Verfassers. *Zeitschrift für Pilzkunde* 17, (alte Folge); 12 (neue Folge), 54-60, 1 pl., Darmstadt, 1933. ISIS

"Der grosse Pilzforscher CHRISTIAN HENDRIK PERSOON (1761-1836; nicht 1755-1837 !), in dessen Nachfolge die systematische Mykologie sich entwickelt hat, ist als biographische Gestalt durchaus schattenhaft. Selbst die einfachsten Daten seines Lebens sind unbekannt geblieben. Der in der botanischen Welt mit einem lebhaften Briefwechsel international überallhin Verbindungsfäden zog, durch seine Bücher berühmt, die Autorität in der Pilzkunde, tat nichts für die Beachtung seiner Persönlichkeit hinzu. Von niemand gesehen, lebte er in mehr als dürftiger Umgebung völlig verarmt in Paris dahin. Selbst Herbar und Bücher gehörten ihm schliesslich nicht mehr, ein Mikroskop fehlte ihm schon lange. Niemand war zugegen, als er starb."

D. — *Medical sciences*

Baumgartner, Leona; Ramsey, Elizabeth Mapelsden. JOHANN PETER FRANK and his "System einer vollständigen medicinischen Polizey." *Annals of medical history* 6, 69-90, 1934. ISIS

Dawson, W. T.; Chapman, John. WITHERING on digitalis, 1785. *Annals of medical history* 6, 31-34, 1934. ISIS

Giordano, D. ANTONIO SCARPA nelle sue lezioni di chirurgia. *Atti della Società Italiana di storia delle scienze mediche e naturali*, 137-39, 1933. ISIS

Haberling, Wilhelm. HEINRICH HEINE's medical ancestors and relatives. *Medical life* 41, 42-48, 3 port., facs., 1934. ISIS

Hutchison, Robert. Medicine in HORACE WALPOLE's letters. *Annals of medical history* 6, 56-68, 1934. ISIS

Pleadwell, Frank Lester. "That remarkable philosopher and physician, WELLS of Charleston." The first exponent of the theory of natural selection, discoverer of the nature of dew, and physician. *Annals of medical history* 6, 128-42, 1934. ISIS

Apropos of WILLIAM CHARLES WELLS (Charleston, South Carolina, 1757-London 1817).

E. — *Alia*

Bessmertny, Bertha. SAVÉRIEN historien des sciences. *Archeion* 15, 369-78, 1933. ISIS

XIXth **Century** (whole and first half)

A. — *Mathematics*

Colman, E. Eine neue Grundlegung der Differentialrechnung durch KARL MARX. *Archeion* 15, 379-84, 1933. ISIS

"Das Moskauer Marx-Engels-Lenin Institut besitzt an hundert Fotokopien von bisher unveröffentlichten Handschriften KARL MARX aus dem Gebiete der Mathematik, der Naturwissenschaften und der Technik. Unter diesen Handschriften, die teilweise kommentierte Auszüge aus verschiedenen Fachwerken enthalten, teilweise selbständige Entwürfe MARXens darstellen, nehmen die mathematischen Arbeiten den ersten Platz ein. Es sind 31 verschiedene Exzerpte aus dem Gebiete der Arithmetik, Algebra, Analysis und Geometrie, 19 selbtständige Entwürfe, vorwiegend die Begründung der Analysis betreffend, und ausserdem Anwendungen der Mathematik in der politischen Oekonomie."

Neumark, S. Note on the life of CHARLES GILL. *Scripta mathematica* 2, 139-42, 1934. ISIS

Born 1805 at Staxton, in the East Riding of Yorkshire, died in 1855. He was "the first actuary in America." G. S.

Watson, G. N. Scraps from some mathematical note-books. Presidential address to the Mathematical Association, 1934. *Math. Gazette* 18, 5-18, port. of WATSON, 1934. ISIS

This address deals with topics referred to in entries in the "Tagebuch" (for the period 1796-1814) of CARL FRIEDRICH GAUSS (1777-1855). R. C. A.

B. — *Physical sciences and technology*

Berzelius, Jac. Briefwechsel. Im Auftrage der Kgl. Schwedischen Akademie der Wissenschaften hrsg. v. H. G. SÖDERBAUM. Upsala. ISIS

Reviewed by EDMUND O. VON LIPPMANN, *Chemiker-Zeitung* 58, 49, 1934. "Nach über zwanzigjähriger mühevoller Tätigkeit war es dem hochverdienten Herausgeber noch in seinem letzten Lebensjahre beschieden, dieses denkwürdige Werk zum Abschlusse zu bringen, und die Korrespondenz mit C. F. RAMMELSBERG (1838-1847), E. MITSCHERLICH (1819-1847), und SVEN NILSSON (1819-1847) in drei Bänden von zusammen 683 S. vorzulegen. Sie umfassen nahezu 300 Briefe."

Dickinson, H. W. JOLLIFFE and BANKS, contractors. The Newcomen Society, *Transactions* 12, 1931-1932, 1-8, 1933. ISIS

Dickinson, H. W.; Titley, Arthur. RICHARD TREVITHICK: the engineer and the man. XVII+290 p., 18 pl. (*Trevithick centenary commemoration memorial volume*). Cambridge, University Press, 1934. ISIS

Faraday, Michael. The chemical history of a candle. In basic English by PHYLLIS ROSSITER. 153 p. (Psyche miniatures). London, KEGAN PAUL, 1933.

Feyerabend, Ernst. Der erste praktisch verwendete elektrische Telegraph. *Beiträge zur Geschichte der Technik und Industrie* 22, 83-86, 1933. ISIS

Hartmann, Ludwig. Unveröffentlichte Briefe des Physikers JEAN-BAPTISTE BIOT (1774-1862). Neue Beiträge zur Geschichte seines Lebens und seiner wissenschaftlichen Arbeiten. *Archeion* 15, 326-38, 1933. ISIS

Letters to LAMAGDELAINE, DUCHESNE, DÉTERVILLE, DIDOT, PINGARD. The letters are insignificant. G. S.

Horwitz, Hugo Th. Das erste Ringschmierlager mit festem Ring und die ersten Blech-Vollscheibenräder. *Beiträge zur Geschichte der Technik und Industrie* 22, 133-34, 1933. ISIS

Lippmann, Edmund O. von. Vor hundert Jahren XIII. *Die Deutsche Zuckerindustrie*, 46-47, (no date, received in 1934). ISIS

Mason, W. W. TREVITHICK's first rail locomotive. The Newcomen Society, *Transactions* 12, 1931-1932, 85-103, 2 fig., 1933. ISIS

Miller, Albert H. Two notable controversies: over the invention of the electric telegraph and the discovery of surgical anesthesia. *Annals of medical history* 6, 110-23, 6 fig., 1934. ISIS

Nierenstein, M. A missing chapter in the history of organic chemistry : the link between elementary analysis by dry-distillation and combustion. *Isis* 21, 123-30, facs., 1934. ISIS

Apropos of Die Entwicklung der Pflanzensubstanz (Erlangen 1810) by C. G. NEES VON ESENBECK, C. G. BISCHOF and H. A. ROTHE. G. S.

(Prout, William). PROUT's hypothesis. Papers by WILLIAM PROUT, M..D (1815-16), J. S. STAS (1860) and C. MARIGNAC (1860). 58 p. (Alembic Club reprints, no. 20), Edinburgh, Published by the Alembic Club, 1932. ISIS

" The change in view regarding PROUT's Hypothesis brought about by twentieth century physical and physico-chemical investigation affords a suitable occasion for reproducing in this reprint the original papers of PROUT and, along with them, two of the most important of the papers dealing with determinations made during the nineteenth century in connection with the hypothesis. The papers by STAS and MARIGNAC sufficiently characterise the aspect that the matter had assumed in 1860 and still presented more than forty years later. Certain details connected with the early history of the hypothesis, together with a number of points correlating the hypothesis with recent advances, are set forth in the historical introduction."

Schiller, L. Drei Klassiker der Strömungslehre : HAGEN, POISEUILLE, HAGENBACH. 97 p., 4 fig. (*Ostwald's Klassiker der exakten Wissenschaften*, Nr. 237). Leipzig, Akademische Verlagsgesellschaft, 1933. ISIS

This includes the three following memoirs : 1. G. HAGEN : Ueber die Bewegung des Wassers in engen cylindrischen Röhren; (Aus POGGENDORFF's *Annalen der Physik und Chemie* 46, 423-42, 1839); 2. POISEUILLE : Experimentelle Untersuchungen über die Bewegung der Flüssigkeiten in Röhren von sehr kleinen Durchmessern; (Aus POGGENDORFF's *Annalen der Physik und Chemie* 58, 424-448, 1843); 3. ED. HAGENBACH : Ueber die Bestimmung der Zähigkeit einer Flüssigkeit durch den Ausfluss aus Röhren; (POGGENDORFF's *Annalen der Physik und Chemie* 109, 385-426, 1860) plus sixteen pages of notes. G. S.

D. — *Medical sciences*

Friedenwald, Harry. The first medical refractionists. *Archives of Ophthalmology* 11, 67-80, 1934. ISIS

Hallema, A. Onderscheiding van overheidswege aan de haagsche doctoren, die deelgenomen hadden aan de cholerabestrijding in 1832. *Bijdragen tot de geschiedenis der geneeskunde* 14, 29-31, 1934. ISIS

McDowell, Ephraim. Original article on ovariotomy. Published in

the Eclectic repertory and analytical review 1817, vii, 242-243-244. Reproduced in facsimile. *Medical life* 41, 89-92, 1934. ISIS

XIXth Century (second half)

A. — *Mathematics*

Prasad, Ganesh. Some great mathematicians of the nineteenth century : their lives and their works. In three vols. Vol. 2, with ten portraits. XVIII+324 p. Printed by S. C. CHATTERJI, at the Mahamandal Press, Benares City, India, and published by the Benares Mathematical Society, 1934. ISIS

The first volume of PRASAD's work was reviewed in *Isis* 22,359. This second volume " deals with the ten mathematicians, CAYLEY, HERMITE, KRONECKER, BRIOSCHI, CREMONA, DARBOUX, G. CANTOR, MITTAG-LEFFLER, KLEIN and POINCARÉ, the writings of every one of whom continue to influence, more or less powerfully, the mathematical thought of to-day. The third volume will deal with a number of similar mathematicians, many of whom are happily still in the land of the living, and will also attempt to give an idea of the progress of mathematical research in America and Asia by presenting the lives and works of certain mathematical investigators belonging to those continents." G. S.

Weiss, E. A. E. STUDYS mathematische Schriften. *Deutsche Mathematiker-Ver. Jahresbericht* 43, 108-24, 1933 ; 211-25, 1934. ISIS

On the last page is a list of the 18 doctoral dissertations under EDWARD STUDY (1862-1930) during the years 1899-1929 at Bonn. WEISS lists according to topics both published and unpublished material. STUDY's life and work were dealt with earlier in the *Jahresbericht* by F. ENGEL (v. 40, 133-56, port., 1931). R. C. A.

B. — *Physical sciences and technology*

Dominke, H. Vom Werden der elektrischen Einheiten. *Beiträge zur Geschichte der Technik und Industrie* 22, 57-62, 1933. ISIS

(Finlayson). History of the firm Finlayson & Co., Aktiebolag, Tammerfors, Finland. The Newcomen Society, *Transactions* 12, 1931-1932, 108-09, 1933. ISIS

Getman, Frederick H. ALEXANDER BORODIN (1834-87), chemist and musician. *Journal of Chemical Education* 8, 1763-80, 2 facs., port., 1931. ISIS

" ALEXANDER BORODIN although better known as a composer was educated

as a physician and entered upon the career of a chemist. He became professor of chemistry in the Medical Academy in St. Petersburg, where he spent fifteen fruitful years in the pursuit of chemical research and in training young men to become chemists. Endowed with exceptional musical talent, which had been carefully cultivated from boyhood, he produced during the spare hours of his mature years many works of musical art which are conceded to rank with the best composition of the nineteenth century. He was also closely identified with various philanthropic causes, chief among which was the movement to secure for the women of Russia the privileges of university education."

Gross, Arnold Th. Die Glühlampe als Wegbereiterin der Elektrizitätswirtschaft. *Beiträge zur Geschichte der Technik und Industrie* 22, 70-76, 2 fig., 1933. ISIS

Sampson, R. A.; Brasch, F. E. JOHN LOUIS EMIL DREYER (1852-1926). *Isis* 21, 131-44, 1 pl., 1934. ISIS

Add to the bibliography, DREYER's contribution to the sixth volume of F. S. MARVIN's Unity Series: *Science and civilization* (Oxford Press 1923). DREYER's paper is entitled: Greek mathematics and astronomy (see *Isis* 6, 120). G. S.

Tschanter, Ernst. Das Erwärmungsproblem in der Geschichte des Elektromaschinenbaues. *Beiträge zur Geschichte der Technik und Industrie* 22, 63-69, 2 pl., 1933. ISIS

Verschaffel, L'abbé **Aloys** (1850-1933). Obituary by AUGUSTE COLLARD. *Bulletin de la société belge d'astronomie, de météorologie et de physique du globe*, n° 4, 8 pl., 1933. ISIS

C. — *Natural sciences*

Davis, William Morris (1850-1934). Obituary by ISAIAH BOWMAN, *Geographical Review* 24, 177-81, port., 1934. ISIS

Howarth, O. J. R.; Howarth, Eleanor K. A history of DARWIN's parish—Downe, Kent. With a foreword by Sir ARTHUR KEITH. VIII + 88 p. Southampton, RUSSELL, 1933. ISIS

MacBride, E. W. ERNST HAECKEL (1834-1914). *Nature* 133, 198-99, 1934. ISIS

Wollaston, Mary. Letters and diaries of A. F. R. WOLLASTON. With a preface by Sir HENRY NEWBOLT. XV + 261 p., 4 port. Cambridge, University Press, 1933 ($ 4.50). ISIS

WOLLASTON was a born wanderer and explorer, a descendant on one side of a family known in the world of science for two centuries, and on the other from a clan devoted to music and the arts. He early exhibited his skill as an observant naturalist, studied medicine and surgery, but later turned to collecting and exploration. Two visits to Lapland (1896, 1897) were followed by two years in the London Hospital, interrupted by holidays of bird-hunting and climbing. In 1900 he explored the Dolomites; in 1901 he went to the Sudan on a collecting expedition, returning again to the desert in 1904. A new expedition to the Far East took him in 1904 on another collecting trip to Australia, New Zealand, New Britain, New Guinea, Java, and Japan. In 1905, he went on the British Ruwenzori Expedition as doctor and botanist, returning from this in 1906 via the Congo. In 1909, he was a member of the British Ornithologists' Union Expedition to New Guinea, resulting in his "Pygmies and Papuans." He returned in 1912-13 and his diaries of this trip are included in the book. He was a naval surgeon from 1914 to 1919, with service in East Africa and Archangel. In 1920, he was appointed to a Fellowship at King's College, Cambridge, but left at once as medical officer and naturalist on the Mount Everest Expedition. This was followed in 1922 by an expedition into the Sierra Nevada range of Colombia. The book is mainly made up of quotations from unpublished diaries which reveal a naturalist-explorer gifted with a rare insight into the phenomena of the organic world. C. A. K.

D. — *Medical sciences*

Bragman, Louis J. The medical wisdom of BRET HARTE. *Annals of medical history* 6, 180-85, 1934. ISIS

His, Wilhelm. WILHELM HIS der Anatom. Ein Lebensbild. IV+79 p., port. Berlin, URBAN SCHWARZENBERG, 1931 (Rm. 3). ISIS

Biography of the great anatomist WILHELM HIS (Bern 1831-1904) with portrait and bibliography, by his son. "Darf aber der Sohn das Leben seines Vaters beschreiben? Bringt nicht die kindliche Verehrung die Gefahr eines wenn auch liebevoll verzerrten Bildes? Ich habe es gewagt. Keiner kennt Wesen und Umgebung eines Menschen so, als wer 40 Jahre in vertrautem Verkehr gestanden; hat er dazu eigene Lebenserfahrung, so mag ihm wohl gelingen, in der Rückschau die Dinge nahe ihrem wahren Mass zu sehen. Ich habe selbst in jüngeren Jahren embryologisch gearbeitet und habe das Fach zeitlebens gern verfolgt. Als Dilettant freilich; aber ich durfte mich der besten fachmännischen Beratung H. K. CORNINGS erfreuen; auch den Anatomen R. FICK, W. SPALTEHOLZ, H. HELD bin ich für wertvolle Mitarbeit aufrichtig dankbar."

Schnabel, Truman G. WILLIAM OSLER at the Philadelphia hospital. *Medical life* 41, 75-88, 1934. ISIS

Sudhoff, Karl. Zum 80. Geburtstage. Von P. DIEPGEN. *Der Chirurg* 5, 862-64, 1933. ISIS

Wellmann, Max (15. März 1863-9. Oktober 1933). Obituary by PAUL DIEPGEN. *Archeion* 15, 439-40, 1933. ISIS

E. — *Alia*

Azevedo, J. Lucio de (1855-1933). Obituary by FIDELINO DE FIGUEIREDO. *Archeion* 15, 424-25, 1933. ISIS

Frazer, Sir James George. A bibliography of Sir JAMES GEORGE FRAZER. Compiled by THEODORE BESTERMAN. With portraits and facsimiles and note by Sir J. G. FRAZER. XII+100 p. 3 pl. London, MACMILLAN, 1934. ISIS

Halkin, Léon. Deux lettres inédites de FUSTEL DE COULANGES au sujet de la Cité Antique. *Mélanges Bidez*, p. 465-74, Bruxelles, 1934. ISIS

Reinach, Salomon (1858-1932). Obituary by EDMOND POTTIER. *Revue archéologique*, 36, 137-54, port., 1932. ISIS

XXth Century

B. — *Physical sciences and technology*

Bloch, M. A. Die Literatur zur Geschichte der Chemie für die letzten Jahre. *Archives of the history of science and technology* 2, 305-13, Leningrad Acad. of Science, 1934 (in Russian). ISIS

Hooreman, Fernand (1878-1933). Obituary by AUG. COLLARD, *Bulletin de la société belge d'astronomie*, nos. 11 et 12, 1933. ISIS

Rutherford, Lord. The new hydrogen. *Nature* 133, 481-84, 1934. ISIS

> "It is of interest to indicate briefly the almost romantic history of this rapid advance in knowledge, and to note that there are certain points of analogy between the discovery of heavy hydrogen and the discovery of argon in the atmosphere by the late Lord RAYLEIGH. In both cases the clue to the discovery depended on the recognition of the importance of small differences observed in accurate measurements of density."

Rynin, N. A.; Vorobyev, A. G.; Krylov, A. N. Feierliche Sitzung des Instituts für Geschichte der Wissenschaft und der Technik, anlässlich des 75-jährigen Geburtstags von K. E. ZIOLKOVSKI.

Archives of the history of science and technology 2, 267-96, port., 12 fig., Leningrad, Acad. of Science, 1934 (in Russian). ISIS

K. E. ZIOLKOVSKI (b. 1857), Russian inventor.

C. — *Natural sciences*

Almeida, José Joaquim de (1862-1933). Obituary by ARLINDO C. MONTEIRO. *Archeion* 15, 420-23, fig., 1933. ISIS

Maude, Aylmer. MARIE STOPES: her work and play. Authorised edition. 299 p., 8 pl. London, DAVIES, 1933. ISIS

Reviewed in *Nature* 133, 123, 1934.

D. — *Medical sciences*

Carbonelli, Giovanni (1859-1933). Obituary by GIUSEPPE MONTALENTI. *Archeion* 15, 418-19, fig., 1933. ISIS

Fontes, Victor. Curriculum vitae. *Arquivo de anatomia e antropologia* 15, 57-88, Lisbon, 1932-1933. ISIS

Jacob, Georg. GEORG JACOB zum siebzigsten Geburtstag, 26. Mai 1932, gewidmet von Freunden und Schülern. Hrsg. von THEODOR MENZEL. VIII+381 p., port., 10 pl. Leipzig, HARRASSOWITZ, 1932. ISIS

E. — *Alia*

Bidez, Joseph. Annuaire de l'Institut de philologie et d'histoire orientales. Tome II (1934). *Mélanges Bidez.* 2 vols., 1064 p., 9 pl. Bruxelles, Secrétariat de l'Institut, 1934. ISIS

This *Festschrift* is analyzed in the present bibliography. Very rich collection of essays, with beautiful portrait, but no introduction, no bibliography, no index. G. S.

Linossier, Raymonde (1897-1930). Etudes d'orientalisme. Publiées par Le Musée Guimet à la mémoire de RAYMONDE LINOSSIER. 2 vols., VII+568 p., 70 pl. Paris, LEROUX, 1932. ISIS

Rostand, Jean ; Boutaric, A. ; Sergescu, P. Tableau du XX^{e} siècle, 1900-1933. Les sciences. Les sciences mathématiques, les sciences biologiques, les sciences physico-chimiques. 499 p., 32 illus. Paris, DENOËL et STEELE, 1933 (25 frs.). ISIS

The title of this book is highly misleading, for it is not a history of science in the twentieth century, but a history of *French* science. To be sure foreign scientists are sometimes mentioned, but the story is focused from beginning to end upon the French achievements. The history of French mathematics (182 p.) is written by PIERRE SERGESCU of Cluj, the history of biology (146 p.) by JEAN ROSTAND, the history of physics and chemistry by AUGUSTIN BOUTARIC (170 p.). G. S.

PART II

HISTORICAL CLASSIFICATION

I. — ANTIQUITY

1. — ANTIQUITY (*generalities*)

Goossens, Roger. Les nāgas et le basilic dans le monde gréco-romain. *Mélanges Bidez*, p. 415-49, Bruxelles, 1934. ISIS

"Le basilic, *βασιλίσκος τῶν δρακόντων*, n'est qu'un des innombrables *nāgarājās* dont les listes remplissent l'épopée sanskrite, un doublet de l'*ὀδοντοτύραννος*, ou si l'on veut, du *σκώληξ*. Mais son adoption par l'Égypte a dû coïncider avec la première apparition en occident d'une notion qui dépassait encore en horreur toutes les précédentes, celle du 'serpent au regard venimeux' (dṛṣṭiviṣa bhogin). Il n'en a pas fallu davantage pour que le basilic devînt, dans toute la force de ce terme, 'le roi des serpents,' pour que l'Europe entière craignît, ou feignît de craindre ses yeux qui donnent la mort : deathdarting eye of cockatrice."

Meyer, Eduard. Die ältere Chronologie Babyloniens, Assyriens und Ägyptens. Nachtrag zu ersten Bande der Geschichte des Altertums. 2., erw. Aufl. v. HANS ERICH STIER. VII+74 p. Stuttgart, COTTA, 1931. ISIS

Reviewed by MAX PIEPER, *OLZ* 37, 149-50, 1934.

Piwowarsky, E. Form- und Giesstechnik in vorchristlicher Zeit. *Beiträge zur Geschichte der Technik und Industrie* 22, 25-28, 1933. ISIS

Quiring, Heinrich. Über die älteste Verwendung und Darstellung von Eisen und Stahl. *Beiträge zur Geschichte der Technik und Industrie* 22, 29-39, 4 pl., 1933. ISIS

Followed by an interesting chronological table of metallurgy from the end of the stone age to our era. G. S.

2. — EGYPT

Antoniadi, E. M. L'Astronomie égyptienne depuis les temps les plus reculés jusqu'à la fin de l'époque Alexandrine. 157 p., 7 pl., Paris, GAUTHIER-VILLARS, 1934. ISIS

This work by an astronomer of the observatory of Meudon, near Paris, was written, according to his own statement, because " Il n'existe pas d'ouvrage qui traite en détail des diverses branches de l'astronomie égyptienne, la plus ancienne et la plus précise, la plus savante et la plus philosophique de toutes avant celle de l'Hellade." Hence this statement indicates at the very beginning that the writer knew nothing of Babylonian astronomy and hence that his later statements should be accepted with great reserve. His method is suggested by the first sentence of the last paragraph of the " avant-propos." This is as follows : " Comme les ouvrages spéciaux sur l'histoire de l'Astronomie ne donnent qu'un très petit nombre de traductions de passages d'auteurs grecs ayant décrit la science égyptienne, j'ai pensé développer surtout ce côté de la question, en copiant et en traduisant tous les textes importants de ces écrivains que j'ai pu trouver à la Bibliothèque Nationale de Paris." Results of modern research are ignored. After introductory chapters on " généralités " and " philosophes grecs, et prêtres égyptiens " (p. 11-44) come chapters : III, " divinités astronomiques et idées sur l'univers " (p. 45-58); IV, " les constellations égyptiennes " (p. 59-80); V, " soleil, lune, planètes et comètes " (p. 81-98); VI, " la terre et le calendrier égyptien " (p. 99-114); VII, " l'astronomie des grandes pyramides " (p. 115-54). Interesting plates reproducing the pyramids and the Denderah zodiac.

R. C. A.

Lint, J. G. De. De BNW-T ziekte der Egyptenaren. *Bijdragen tot de geschiedenis der geneeskunde* 14, 45-47, 1934. ISIS

Lint, J. G. De. Egyptische specialisten. *Bijdragen tot de geschiedenis der geneeskunde* 14, 48-52, 1934. ISIS

Lippmann, Edmund O. von. Chemisches, Pharmazeutisches und Technologisches aus dem " Papyrus Erzherzog Rainer." *Chemiker-Zeitung* 57, 1009, 1933. ISIS

Sandford, K. S. ; **Arkell, W. J.** Paleolithic man and the Nile Valley in Nubia and Upper Egypt. A study of the region during Pliocene and Pleistocene times. XVII+92 p., 43 pl., 1 map. (*The University of Chicago Oriental Institute Publications* 17, Prehistoric survey of Egypt and Western Asia, vol. 2). Chicago, University Press, 1933. ISIS

Reviewed by JOHANNES WALTHER, *OLZ* 37, 213-14, 1934; by GEORGE GRANT MACCURDY, *American historical review* 39, 552, 1394.

3. — BABYLONIA AND ASSYRIA

Krause, Arlington C. Assyro-Babylonian ophthalmology. *Annals of medical history* 6, 42-55, 2 fig., 1934. ISIS

Thureau-Dangin, F. Notes assyriologiques. *Revue d'assyriologie* 30, 183-88, 1933. ISIS

Contents: LXXIV, Igû et igibû; LXXV, La tablette de Strasbourg nº 11; LXXVI, Le nom du " cercle " en babylonien.

Thureau-Dangin, F. Notes assyriologiques. *Revue d'assyriologie* 31, 49-52, 1934. ISIS

LXXVII. Nombres ordinaux et fractions en accadien; LXXVIII, Carré et racine carrée.

Thureau-Dangin, F. La tablette de Strasbourg no 11. *Revue d'assyriologie* 31, 30, 1934. ISIS

4. — GREECE

Berthelot, André. Les données numériques fondamentales de la géographie antique d'ÉRATOSTHÈNE à PTOLÉMÉE. *Revue archéologique* 36, 1-34, 1932. ISIS

" En résumé, les observations astronomiques laissaient peu à désirer, facilitées par la consultation du *Memento* d'HIPPARQUE; les estimations de distances routières étaient exactes, mais la sous-estimation de la valeur du degré a mis obstacle à la coordination des deux sources des calculs du canevas géographique; l'inaptitude des Anciens à mesurer directement les angles a faussé la direction des itinéraires terrestres et nautiques, de sorte que pour faire concorder les mesures astronomiques et les mesures terrestres, on a déformé les pays, allongeant l'Italie vers le sud-est, l'Espagne vers le sud-ouest, orientant la Petite Bretagne (Écosse) à angle droit de la Grande-Bretagne, vers l'est, aplatissant la péninsule de l'Inde, etc. PTOLÉMÉE, mieux documenté qu'AGRIPPA qui avait négligé les observations scientifiques, rectifie les fautes de ses prédécesseurs, mais incomplètement, paralysé par l'erreur initiale sur les dimensions de la sphère terrestre. Comparé à celui d'ERATOSTHÈNE, son horizon s'est élargi par l'exploration du bassin du Volga, les relations de voyages terrestres vers la Mongolie et la Chine du nord, de voyages maritimes vers l'Insulinde et la Chine du sud, et aussi le long du rivage oriental d'Afrique; vers l'occident, les marins de Gadès ont apporté des informations, mais l'effacement de la marine celtique a fait oublier le chemin de l'Islande; là seulement il y a régression. Malgré l'avance vers le sud qui porte la frontière des pays reconnus au 15*e* degré de latitude australe, tandis qu'on l'arrêtait vers le nord au 63°, la largeur de l'Oecumène n'est évaluée qu'à 39.000 stades, alors que du pays de la cannelle à Thulé, entre le 12°

et le 66° latitude nord, HIPPARQUE en mesurait 37.800; tel était l'effet de la fausse observation de l'étoile Canope par POSIDONIOS. Elle n'influait pas sur l'estimation de la longueur, fondée exclusivement sur des mesures routières. PTOLÉMÉE la fixait à 180 degrés, valant, sur le parallèle de Rhodes, 72.000 stades. Les positions directement déterminées étaient un peu en dedans de ce cadre : du cap Sacré (Saint-Vincent) au 2°30', à la ville de Sera (Si-ngan) au 177°15', la distance était sensiblement 70.000 stades, chiffre traditionnel. A vol d'oiseau, nous l'estimons aujourd'hui à 67.500 stades. Que l'on envisage les mesures d'ensemble ou les mesures partielles, on en reconnaît l'exactitude relative qui est remarquable et n'a pu être méconnue que par les commentateurs qui se sont trompés sur l'unité de mesure employée par PTOLÉMÉE, tout de même que le grand astronome alexandrin s'était trompé quand, pour traduire les constatations astronomiques en données cartographiques, il avait choisi la valeur unitaire du degré calculée par POSIDONIOS au lieu de la valeur presque exacte déterminée par ÉRATOSTHÈNE. L'erreur commise en observant la hauteur de l'étoile α du Navire a faussé pour quinze siècles la physionomie de la carte du monde; mais, tardive compensation, elle a suscité la découverte de l'Amérique."

Bögel, K. Aus dem mathematischen Schrifttum der Griechen. *Eclogae Graecolatinae*. Fasc. 54. 32 p. Leipzig, TEUBNER, 1930. ISIS

Reviewed by E. J. DIJKSTERHUIS, *Euclides* 7, 275, 1930-31.

Bosch, F. Ueber die quadratischen Irrationalitäten in der griechischen Mathematik. *Jahresbericht der D.M.V.* 41, 59-72, 1931. ISIS

Reviewed in *Euclides* 9, 32, 1932-33.

Büttner, Heinrich. Griechische Privatbriefe. 40 p. (Schriften d. Hessischen Hochschulen. Universität Giessen. Jahrg. 1931, H. 3 : *Mitteilungen aus d. Papyrussammlung d. Giessener Universitätsbibliothek*, 3.). Giessen, TÖPELMANN, 1931. ISIS

Reviewed by BROR OLSSON, *DLZ* 3, 679-80, 1932.

Carpenter, Rhys. The antiquity of the Greek alphabet. *American Journal of Archaeology* 37, 8-29, 1933. ISIS

Reviewed by O. G. S. C., *Antiquity* 7, 364, 1933.

Cary, Max. A history of the Greek world from 323 to 146 B.C. XVI+ 448 p., 3 maps. (*Methuen's history of the Greek and Roman world*, 3). London, METHUEN, 1932. ISIS

Casson, Stanley. Some technical methods of archaic sculpture. *Journal of Hellenic Studies* 50, 313-26, 7 fig., 1930. ISIS

Cumont, Franz. ANTIOCHUS d'Athènes et PORPHYRE. *Mélanges Bidez*, p. 135-56, Bruxelles, 1934. ISIS

"*L'Introduction à l'Apotélesmatique* de PORPHYRE offre cet intérêt particulier de nous avoir conservé de longs extraits d'un des plus anciens ouvrages que les Grecs aient consacrés à l'astrologie. ANTIOCHUS d'Athènes est un auteur dont le nom apparaît souvent dans les recueils byzantins de miscellanées astrologiques, mais les morceaux mis sous son nom ne lui appartiennent pas tous et par suite la date où il écrivit s'est trouvée difficile à déterminer. L'on admet d'ordinaire — et moi-même j'ai exprimé cette opinion — qu'il vécut après PTOLÉMÉE et VETTIUS VALENS, vers l'an 200 de notre ère. Mais le dépouillement des manuscrits de Paris a apporté la preuve certaine que les citations qu'on lui attribue de ces deux prétendus devanciers, se trouvent en réalité dans un ouvrage de RHÉTORIUS l'Égyptien, faussement mis sous son nom, et ce *terminus post quem* est donc inexistant. Sans prétendre passer au crible tous les textes dont les Byzantins, les Arabes ou les érudits modernes ont rendu ANTIOCHUS responsable — examen qui dépasserait de beaucoup les limites de cet article — nous nous bornerons à constater que sa paternité n'est sûrement attestée que pour un seul ouvrage, les *Εἰσαγωγικά*. En effet, un chapitre de cette *Introduction* est cité par PORPHYRE et, indépendamment de lui, par HÉPHAISTION de Thèbes comme étant d'ANTIOCHUS. Celui-ci est appelé par HÉPHAISTION, dans ce passage, *Ἀντίοχος ὁ Ἀθηναῖος* et cette indication de sa patrie est le seul renseignement biographique que nous possédions sur sa personne. Mais nous avons conservé de ses *Εἰσαγωγικά*, qui comprenaient deux livres, un précieux sommaire, composé par un lecteur byzantin qui, à la façon de PHOTIUS dans sa Bibliothèque, a rédigé des analyses concises indiquant, chapitre par chapitre, le contenu d'une série d'œuvres astrologiques, dont les unes sont conservées et les autres perdues."

Fabricius, Knud. Das antike Syrakus. Eine historisch-archäologische Untersuchung. 30 p., 21 pl., 1 map. (*Klio*, Beitr. zur alten Gesch., Beiheft 28). Leipzig, DIETERICH, 1932. ISIS

Reviewed by ARMIN VON GERKAN, *DLZ* 4, 1404-07, 1933.

Geffcken, J. Philosophie und Einzelwissenschaft in der Antike. *Mélanges Bidez*, p. 397-414, Bruxelles, 1934. ISIS

Gernet, Louis; Boulanger, André. Le génie grec dans la religion. XLII+538 p. (Bibliothèque de synthèse historique). Paris, Renaissance du Livre, 1932. ISIS

Reviewed by IVAN M. LINFORTH, *American historical review*, 39, 97-98, 1933.

Gudmund, Björck. Zum Corpus hippiatricorum Graecorum. Beiträge zur antiken Tierheilkunde. 91 p. Diss. Uppsala, Lundequiska Bokhandeln, 1932. ISIS

Hagstroem, K. G. Les préludes antiques de la théorie des probabilités. 54 p. Stockholm, FRITZES, 1932. ISIS

Apropos of PLATO's *Timaeus* and SEXTUS EMPIRICUS. Reviewed by HELEN M. WALKER, *Scripta mathematica* 1, 162-64, 1932.

Heath, Sir Thomas L. Greek astronomy. LVII+192 p. (The Library of Greek thought). London, DENT, 1932 (5 s.). ISIS

This is a collection of extracts of the Greek astronomical writings from THALES to PLUTARCH with a brief introduction (45 p.). Says the author: "Most of the translations herein have been made by myself at different times. A large number of the passages were included in my sketch of the early history of Greek astronomy which forms the bulk of *Aristarchus of Samos, the Ancient Copernicus*, published in 1913." Some of the passages from the Doxography are borrowed from JOHN BURNET: *Early Greek philosophy* (4th ed., 1930) See *Isis* 21, 423. G. S.

Heidel, William Arthur. The heroic age of science. The conception, ideals, and methods of science among the ancient Greeks. VII+203 p. Baltimore, WILLIAMS & WILKINS, 1933. ISIS

Reviewed by GEORGE SARTON, *Isis* 21, 220-24, 1934.

Herzog, Rudolf; Dittrich, Paul; Listmann, Karl. Vox Graeca. Griechisches Lesebuch für die oberen Klassen, für Studierende und für Freunde humanistischer Bildung. *Das Zeitalter des Hellenismus*. Bd. 1: Der hellenistische Mensch. X+123 p., 15 fig. Leipzig, DIETERICH, 1932. ISIS

Reviewed by J. GEFFCKEN, *DLZ* 4, 1837-38, 1933.

Herzog, Rudolf. Die Asklepiosheiligtümer als Heilstäten und Gnadenorte. *Jubiläumsgabe d. Münch. med. Wschr.* S. 1-4, 5 Abb. München, LEHMANN, 1933. ISIS

Licht, Hans. Sexual life in ancient Greece. Translated by J. H. FREESE. Edited by L. H. DAWSON. XV+557 p., 32 pl. London, ROUTLEDGE, 1932. ISIS

Reviewed in *Nature* 130, 262, 1932.

Lietzmann, W. Eine stereometrische Aufgabensammlung aus vorchristlicher Zeit. *Z. math. nat. Unterr.* 64, 34-35, 1933. ISIS

Luria, S. Neuerscheinungen aus dem Gebiet der Geschichte der antiken Mathematik. *Archives of the history of science and technology* 2, 297-304, Leningrad, Acad. of Science, 1932 (in Russian). ISIS

Reviews of the following two books: G. JUNGE, *Besonderheiten der griechischen Mathematik. Jahresbericht der deutschen Mathematiker-Vereinigung* 35, 66-80, 150-72, 251-68, 1926; H. HASSE, *Die Grundlagenkrisis der griechischen Mathematik*. Mit einem Anhang von H. SCHOLZ: Warum haben die Griechen die Irrationalzahlen nicht aufgebaut? Charlottenburg, Pan-Verlag, 1928.

Marotte, F. La mesure de la terre dans l'antiquité. *L'Enseignement scientifique* 4, 108-14, 2 fig.; 269-75, 1931. ISIS

Meyerhof, Max. Die Operation des Stars in der griechischen Medizin. *Die Antike* 9, 72-80, 1932. ISIS

Mountford, J. F. A new fragment of Greek music in Cairo. *Journal of Hellenic Studies* 51, 91-100, 1931. ISIS

Payne, Humfry. Necrocorinthia : a study of Corinthian art in the archaic period. XII+363 p., 53 pl., illus. Oxford, Clarendon Press, 1931. ISIS

Preisendanz, Karl. Papyri Graecae magicae. Die griechischen Zauberpapyri. II. Hrsg. u. übersetzt. Unter Mitarb. von ERICH DIEHL, SAM. EITREM, ADOLF JACOBY. XV+216 p., 3 pl. Leipzig, TEUBNER, 1931. ISIS

Reviewed by HABERLING, *Mitteilungen zur Geschichte der Medizin* 31, 76, 1932; by M. GASTER, *Journal of the Royal Asiatic Society* 639-41, 1932.

Rey, Abel. La jeunesse de la science grecque. XVII+537 p. (Bibliothèque de synthèse historique, L'évolution de l'humanité. La science dans l'antiquité, 2). Paris, La Renaissance du Livre, 1933. ISIS

Reviewed by GEORGE SARTON, *Isis* 21, 224-26, 1934.

Richardson, Bessie Ellen. Old age among the ancient Greeks : the Greek portrayal of old age in literature, art, and inscriptions, with a study of the duration of life among the ancient Greeks on the basis of inscriptional evidence. XV+376 p. (*The Johns Hopkins University studies in archaeology*, no. 16). Baltimore, Johns Hopkins Press, 1933. ISIS

Reviewed by HAROLD N. FOWLER, *American historical review* 39, 153, 1933.

Richter, Gisela M. A. The sculpture and sculptors of the Greeks. Second edition. XXXV+613 p., 767 fig. New Haven, Yale University Press, 1930. ISIS

First edition, 1929. Reviewed by ANDREAS RUMPF, *DLZ* 4, 1418-19, 1933.

Rome, A. Un nouveau renseignement sur CARPUS. *Mélanges Bidez*, p. 813-18, Bruxelles, 1934. ISIS

Apropos du chorobate de CARPUS D'ANTIOCHE cité par THÉON D'ALEXANDRIE : c'était un instrument de nivellement. Ce CARPUS vivait probablement au I ou II s. av. J. C. G. S.

Simon, Franz. Das Corpus hippiatricorum Graecorum von E. Oder und C. Hoppe in seiner Bedeutung als Sammelwerk griechisch-römischer Überlieferungen in griechischer Sprache über Heilbehandlung von Tieren in den nach-christlichen Jahrhunderten unter besonderer Berücksichtigung des damaligen Standes der Veterinär-Chirurgie. 80 p. (Diss. München, 1929. Murnau, Fürst, 1930. ISIS

Stenzel, Julius. Anschauung und Theorie in der klassischen Theorie der griechischen Mathematik. *Forsch. u. Fortschr.* 9, 94-95, 1933. ISIS

Vollgraff, W. Influences orientales dans la civilisation hellène et moderne. *Mélanges Bidez*, p. 993-1005, Bruxelles, 1934. ISIS

Wace, Alan John Bayard. Chamber tombs at Mycenae. *Archaeologia*, vol. LXXXII. XIII+242 p., LVII pl. Oxford, Society of Antiquaries, 1932. ISIS

Wilamowitz-Moellendorff, Ulrich von. Der Glaube der Hellenen. Bd. I, VII+412 p.; Bd. II, VII+620 p. Berlin, Weidmann, 1931-32. ISIS

Reviewed by Martin P. Nilsson, *DLZ* 2, 1825-31, 1931; 3, 2065-74, 1932.

Zuretti, C. O. Catalogue des manuscrits alchimiques Grecs. Vol. 8 : Alchemistica signa digessit et explanavit C. O. Zuretti. VIII+84 p., 17 pl. Brussels, 1932. ISIS

Reviewed by J. Ruska, *DLZ* 3, 2106-08, 1932. See *Isis* 19, 440. G. S.

5. — ROME

Bailey, Cyril. Phases in the religion of ancient Rome. (*Sather classical lectures*, 10). Berkeley, Univ. of California Press, 1932. ISIS

Brown, Gerard Baldwin. Roman engineering works and their aesthetic character : The Pont du Gard. *Journal of Roman studies* 22, 47-54, 1932. ISIS

Buckland, William Warwick. A text book of Roman law from Augustus to Justinian. Second edition. XVI+764 p. Cambridge, University Press, 1932. ISIS

Burn, Andrew Robert. The Romans in Britain. An anthology of inscriptions. With translations and a running commentary. 228 p., frontispiece, pl. Oxford, BLACKWELL, 1932. ISIS

The Cambridge ancient history. Edited by S. A. COOK, F. E. ADCOCK, M. P. CHARLESWORTH. Vol. IX : The Roman Republic, 133-44 B.C. XXXI+1022 p. Cambridge, University Press, 1932. ISIS

Reviewed by ALLEN B. WEST, *American historical review* 39, 94-96, 1933.

Carcopino, Jérôme. Ce que Rome et l'Empire romain doivent à la Gaule. 36 p. (*Zaharoff lecture*). Oxford, Clarendon Press, 1932. ISIS

Ciaceri, Emanuele. Storia della Magna Grecia. Volume 3., Decadenza e fine degli stati Italioti : Romanizzazione del mezzogiorno d'Italia dalla metà del IV sec. A. C. al sec. VI D. C. XII+351 p. Rome, ALBRIGHI, SEGATI, 1932. ISIS

Reviewed by ALLAN CHESTER JOHNSON, *American historical review* 38, 306-08, 1933.

Ciccotti, Ettore. Valore e utilizzazione di dati statistici del mondo antico, con particolare riguardo alla popolazione dell' antica Roma. 25 p. Rome, Istituto poligrafico, 1931. ISIS

Reviewed by MAURICE BESNIER, *Journal des savants*, 181-82, 1932.

Diepgen, Paul. Der Untergang der antiken Welt und die Medizin. *Jahreskurse für ärztliche Fortbildung*, 13 p., Januar, 1934. ISIS

Dijksterhuis, Eduard Jan. Een Romeinsche methode ter vergelijking van de soortelijke gewichten van vloeistoffen. *Hermeneus*, 3, 7-10, 1930. ISIS

Ebeling, August ; Loeschmann, Arnold. Kupfernägel der Nemisee-Schiffe. *Beiträge zur Geschichte der Technik und Industrie* 22, 40-43, 1933. ISIS

(Ecole française de Rome). L'histoire et l'œuvre de l'Ecole française de Rome. 358 p., 12 pl. Paris, DE BOCCARD, 1931. ISIS

Reviewed by L. A. CONSTANS, *Journal des savants*, 416-21, 1932.

Forrer, Robert. Strasbourg-Argentorate : préhistorique, gallo-romain, et mérovingien. 2 vols., 884 p., 610 illus., 154 pl. Strasbourg, Librarie Istra, 1930. ISIS

Reviewed by R. G. COLLINGWOOD, *Antiquity* 7, 103-04, 1933.

Gagnér, Anders. Zur römischen Zeitrechnung. Strena philologica Upsaliensis, p. 202-23, Upsala, 1922. ISIS

Grenier, Albert. Manuel d'archéologie gallo-romaine. Première partie : Généralités — travaux militaires. Préface de CAMILLE JULLIAN. V+619 p., 1 map, 231 fig. Deuxième partie : L'archéologie du sol, routes — navigation — occupation du sol. 2 vol. 1000 p., 320 fig., 5 maps. (Manuel d'archéol. préhistorique, celtique et gallo-romaine. 5 et 6). Paris, PICARD, 1933-34. ISIS

Part 1 reviewed by J. B. KEUNE, *DLZ* 4, 2234-40, 1933.

Jolowicz, H. F. Historical introduction to the study of Roman law. XXII+546 p. Cambridge, University Press, 1933. ISIS

"The author's object has been to supplement Professor BUCKLAND's *Text-Book* and *Manual* and to give the student what he needs to know about Roman law rather than the Roman law itself."

Kieckers, Ernst. Historische lateinische Grammatik. Mit Berücksichtigung des Vulgärlateins und der romanischen Sprachen. I. Tl. : Lautlehre ; II. Tl. : Formenlehre. XXIV+167 p. ; VIII+334 p. München, HUEBER, 1930-31. ISIS

Reviewed by J. B. HOFMANN, *DLZ* 3, 2272-75, 1932.

Macdonald, Sir George. Roman Britain, 1914-1928. 114 p., 23 fig., 16 pl. (British Academy Supplemental Papers, no. 6). London, MILFORD, 1931. ISIS

Reviewed by C. E. STEVENS, *Antiquity* 7, 109-11, 1933.

Majuri, Amedeo. Studi e ricerche sulla fortificazione di Pompei. p. 113-286, 12 pl., 73 fig. (*Monumenti Antichi pubblicati per cura della R. Accademia dei Lincei*, vol. XXXIII.) Rome, 1930. ISIS

Reviewed by A. VON GERKAN, *DLZ* 2, 1949-52, 1931.

Millosevich, Federico. Le scienze fisiche e biologiche in Roma e nel Lazio. Con la collaborazione di vari autori. VIII+379 p., 32 pl. (Istituto di studi romani). Rome, Leonardo da Vinci, 1933. ISIS

Reviewed by ALDO MIELI, *Archeion* 15, 261-66, 2 fig., 1933.

Nasini, R. Boric acid in the glaze of the sealed vases of Arezzo. *Nature* 126, 877, 1930. ISIS

Sheldon, Gilbert. The transition from Roman Britain to Christian

England (A.D. 368-664). XXIII+219 p., map. London, MACMILLAN, 1932. ISIS

Reviewed by R. G. COLLINGWOOD, *Antiquity* 7, 111-13, 1933.

Styger, Paul. Die römischen Katakomben. Archäologische Forschungen über den Ursprung und die Bedeutung der altchristlichen Grabstätten. XII+368 p., 126 fig., 4 pl. Berlin, Verl. f. Kunstwissenschaft, 1933. ISIS

Reviewed by O. WULFF, *DLZ* 5, 404-13, 1934.

Testi, Gino. Sulla presenza dell'acido borico nelle ceramiche aretine. *Archeion* 15, 247-48, 1933. ISIS

Wheeler, R. E. M. Notes on building-construction in Roman Britain. *Journal of Roman Studies* 22, 117-34, 5 fig., 2 pl., 1932. ISIS

Whittick, G. Clement. Roman mining in Britain. The Newcomen Society, *Transactions* 12, 1931-1932, 57-77, 1933. ISIS

Worsfold, Sir **Thomas Cato.** The history of the Vestal virgins of Rome. 160 p., front., pl. London, RIDER, 1932. ISIS

II. — MIDDLE AGES

6. — MIDDLE AGES (*generalities*)

Cantarella, Raffaele. Una tradizione Ippocratica nella scuola Salernitana : il giuramento dei medici. *Archeion* 15, 305-20, 1933. ISIS

" Attestata dunque questa continuità della tradizione classica in Italia Meridionale e della diretta conoscenza di alcune opere ippocratico-galeniche in Salerno, ne consegue che la consuetudine del giuramento è per certo di molto più antica dei documenti che l'attestano, e che essa, con tutta la dottrina della Scuola, rappresenta veramente il filo diretto di una tradizione di cultura e di scienza, a volte splendida a volte oscura, ma non mai interrotta."

Mžik, Hans v. Erdmessung, Grad, Meile und Stadion. Nach den altarmenischen Quellen. Ein Beitrag zur Geschichte der Erdkunde und der Kulturbeziehungen zwischen Hellenismus und Armeniertum. 129 p. (*Studien zur armenischen Geschichte*, 6). Wien, Mechitharisten-Buchdruckerei, 1933. ISIS

" Die inneren Beziehungen zwischen unseren Texten und ihren Quellen lassen sich in einem kurzen Satz charakterisieren : Die von uns untersuchten

armenischen Texte sind durchaus ein Stück hellenistischen Schrifttums. Sofern sie sich nicht von vornherein als Übersetzungen bekannter griechischer Quellen erwiesen haben, konnten wir feststellen, dass sie sich in vollständiger sachlicher und gedanklicher Übereinstimmung mit den sonst in der hellenistischen Literatur überlieferten Nachrichten und Daten befinden. Diese Treue in der Wiedergabe des Gelesenen oder Gehörten wird begreiflich, wenn wir uns vergegenwärtigen, dass die armenischen Autoren fremdes, ihnen auch sonst wenig adäquates Kulturgut übernahmen und zu ihren Vorbildern vollständig im Verhältnis des Schülers zum Lehrer standen. Das gibt uns aber zugleich die Gewähr, dass sie auch dort nicht Eigenes zu sagen haben, wo sie mehr bringen als die erhaltengebliebene hellenistische Tradition. Vielmehr liegt die Sache so, dass sie eine Reihe von Nachrichten bewahrt und überliefert haben, die wir sonst als verloren betrachten müssten. Deshalb sind die armenischen Berichte über die von uns untersuchten Fragen als ein wichtiger Beitrag zur Geschichte der Erdkunde bei den Griechen und zur antiken Metrologie zu werten, dem die gebührende Geltung nicht länger versagt werden darf."

Peate, Iorwerth C. The nine huntings. *Antiquity* 8, 73-80, 1934. ISIS

" In his appendix (pages 84-5) to his *Changes in the fauna of Wales within historic times*, Mr. COLIN MATHESON, refers to ' the old Welsh text known as *Y Naw Helwriaeth* or *The nine huntings* [which] has been generally regarded as setting forth the hunting customs among the early Welsh.' This text has been published in the *Myvyrian archaiology* (2nd edition, pp. 872-3) and in Dr. JOHN DAVIES's *Dictionarium duplex* (1632). Both these printed texts however differ in various details from the three known manuscript versions, and while the versions of two of the manuscripts are fairly similar, that of the third differs markedly from the other two. An edition with annotations in Welsh of the three manuscript texts was published (for the first time) by the present writer in 1933. It was thought that since the texts presented problems of interest to students of British history, a collated translation of the two texts together with a translation of the third, and differing, text would prove to be of value to those unacquainted with Welsh."

Pirenne, H. La fin du commerce des Syriens en Occident. *Mélanges Bidez*, p. 677-87, Bruxelles, 1934. ISIS

" Jusqu'à nouvel ordre, on peut donc continuer à croire qu'il n'y a plus eu de marchands syriens en Gaule après la fin du VII^e^ siècle."

Thorndike, Lynn. Check-list of rotographs in the history of natural and occult science. *Isis* 21, 145-68, 1934. ISIS

" It may be of some service to students of the history of science and error, especially those in this country, to publish a summary list of rotographs now in my possession which will eventually be deposited in the Columbia university library. The rotographs are mainly of manuscripts in European libraries, and the majority of these of works of the fourteenth and fifteenth centuries, but there are also some from incunabula or other early modern printed works."

Vera, Francisco. Introducción de la ecuación de segundo grado en Europa. *Archeion* 15, 321-25, 1933. ISIS

7. — BYZANTIUM

Delatte, A.; Josserand, Ch. Contribution à l'étude de la démonologie byzantine. *Mélanges Bidez*, p. 207-32, Bruxelles, 1934. ISIS

Tillyard, H. J. W. A Byzantine musical handbook at Milan. *Journal of Hellenic Studies* 46, 219-22, 1926. ISIS

"I put forward the view some years ago that the socalled eight modes of the modern Greek or Chrysanthine system were based on Arabo-Persian scales, borrowed through the Turks. A full confirmation of this opinion is supplied by some phonographic experiments of Père THIBAUT, who found that the modes as sung by a Greek archimandrite corresponded minutely to some of the Arabian varieties. The notion still current in England, that the Chrysanthine system contains the Byzantine tradition, must therefore be given up; but we may still assume that Byzantine melodies have survived, though not untouched by Oriental influences, in contemporary Greek Church music. A purer tradition may probably be found among the Graeco-Albanian colonies in Sicily."

III. — ORIENTAL SCIENCE AND CIVILIZATION

9. — INDIA

Datta, Bibhutibhusan. Introduction of Arabic and Persian mathematics into Sanskrit literature. *Proc. Benares Mathematical Society*, 14,7-21, 1932. ISIS

Although this is the volume for 1932 it does not seem to have been printed until 1934. It is stated that "ABU RAIHAN MUHAMMAD IBN AHMED AL-BIRUNI (973-1048 A.D.), the celebrated Persian mathematician, astronomer, chronicler and traveller, seems to have been the first, as far as known, to attempt to introduce Persian mathematics into Sanskrit." The following are also discussed: MAHENDRA SURI (fourteenth century), KAMALAKARA (seventeenth century), JAGANNATHA, alias SAMRĀT JAGANNATHA, "better known as SAVAI JAYASIMHA" (eighteenth century), NAYANESUKHA UPADHYAYA (eighteenth century), and VEDĀṄGRĀYA (seventeenth century). R. C. A.

Lalou, Marcelle. Un traité de magie bouddhique. *Etudes à la mémoire de Raymonde Linossier*, 2, 303-22, Paris, LEROUX, 1932. ISIS

"Le *Mañjuśrīmūlakalpa*, tel qu'il a été édité par GAṆAPATI ŚĀSTRI, contient un chapitre dont la présence dans cette compilation pose un curieux problème. En effet, le chapitre porte en tête le n° 41, à la fin le n° 39; d'autre part, le morceau ne fait pas partie des traductions tibétaine et chinoise du

Mañjuśrīmūlakalpa. Cependant, le texte est ancien puisque AMOGHAVAJRA l'a traduit en chinois vers 775 comme un sūtra indépendant." Ce chapitre " décrit des rites de quatre sortes : curatifs, d'asservissement, propitiatoires et maléfiques. Les rites curatifs sont les plus curieux. Ils sont consacrés à la guérison des morsures de serpents. Quelques pratiques sont étranges et les plus compliquées ne sont données que par la version chinoise. Les rites d'asservissement visent aussi les serpents, mais leur domptage n'est qu'une préoccupation secondaire, un moyen."

Loria, Gino. La geometria degli altari eretti in onore di BRAHMA. *Archeion* 15, 385-407, 2 fig., 1933. ISIS

Apropos of B. DATTA's book (Calcutta 1932) of which a long review has appeared in *Isis* 22, 272-7. G. S.

Müller, Reinhold F. G. Die Medizin der JĀTAKA's. Eine medizingeschichtliche Studie. *Janus* 32, 255-77, 1928. ISIS

Müller, Reinhold F. G. Yoga-Wunder. *Die medizinische Welt*. Nr. 50, 4 pl., 1928. ISIS

Stapleton, H. E. A " line of time " for Northern Bengal. *Journal and Proceedings, Asiatic Society of Bengal* 28, 131-45, 1933. ISIS

Elaborate chronology of N. Bengal with archaeological references from 313 B.C. to 1202. G. S.

10. — CHINA

Edgar, J. H. The Romans of the Szechwan marches. *Journal of the West China border research society* 5, 26, 1932. ISIS

This paper is so short that we copy it verbatim with the author's permission. " The Moslems in many parts of west China insist that their ancestors came from ' Rum.' The local languages give us no information and we are forced to conclude that *rum* here, as in *Rum*ania and Erze*rum* means ' Rome.' Moreover, it also demands that we consider the ancestors of the Moslems in China as immigrants from Asiatic colonies of the Caesars when the Byzantine rulers were masters. The fact that in Tibet ' Rum ' is still the name for the Turkish dominions, shows how conquering nations sought to absorb names as well as empires, and the agents of the Prophet evidently saw no reason, when in distant exile, to deny their connection wirh China's former imperial counterpart in the West. The arrivals of these emissaries of MOHAMET was between 700 and 800 A.D. They came as ' Romans,' and their descendants 1200 years later in the back-washes of Asia still affirm with no uncertain sound, ' We are Romans ! ' "

Gervais, Albert. AESCULAPE en Chine. 253 p. Paris, GALLIMARD, 1933 (15 fr.). ISIS

Souvenirs d'un médecin français qui a enseigné la médecine à Tchentu, Szetchouan pendant de longues années. Ses réflexions sont à rapprocher de celles de A. F. LEGENDRE (*Isis* 15, 457) dont les expériences et les réactions furent semblables. Doit servir de complément et de correctif à ceux qui étudient la médecine chinoise dans HÜBOTTER (*Isis* 14, 255-69) ou dans WONG et WU (*Isis* 20, 480-2). G. S.

Hummel, Arthur W. (and others). Division of orientalia. Report of the librarian of Congress for the fiscal year ending June 30, 1933. VI+264 p., illus., figs. Washington, Government Printing Office, 1933. ISIS

This report includes notes by WALTER T. SWINGLE on early Chinese records of maize, natural products and on medicine. The earliest record of maize is dated 1573 (p. 119). G. S.

Maspero, Henri. Notes sur les travaux archéologiques chinois de TONG TSO-PIN (1928) et KOUO MO-JO (1930). *Journal asiatique*, 222, 1-18, 1933 (publié en mars 1934). ISIS

Morse, W. R. A memorandum on the Chinese procedure of acupuncture. *Journal of the West China border research society* 5, 153-320, 6 pl., figs., 1932. ISIS

Very elaborate paper on acupuncture with tables and schemas illustrating the ideology upon which Chinese medicine is based. A very useful supplement to the histories of Chinese medicine available to western scholars (chiefly HÜBOTTER 1929, *Isis* 14, 255-69, and WONG and WU 1932, *Isis* 20, 480-2). G. S.

12. — ISRAEL (*Including works devoted to Palestine*)

Alder, Elkan Nathan. Jewish travellers. Edited, with an introduction XXIV+391 p. (The Broadway travellers). London, ROUTLEDGE, 1930.

This book is a very free adaptation of the Hebrew collection edited and annotated by J. D. EISENSTEIN : *Ozar massaoth* (352 p. quarto with maps, notes and index, New York 1926, (*Isis* 11, 147-9). " It begins with the ninth and ends in the middle of the eighteenth century. Some of the Palestine itineraries have been omitted; the texts are frequently abridged, and the translations are not always original. The main object of the work has been to give a conspectus of Jewish travel during the Middle Ages, and no attempt has been made to provide a critical edition of the various texts." G. S.

Baumgartner, Walter. Israelitische und altorientalische Weisheit. 34 p. (*Sammlung gemeinverständlicher Vorträge und Schriften aus dem Gebiet der Theologie und Religionsgeschichte*, 166). Tübingen, MOHR, 1933. ISIS

Cohen, D. E. De Joodsche geneeskundigen in de noordelijke Nederlanden voor 1600. *Bijdragen tot de geschiedenis der geneeskunde* 14, 33-43, 1934. ISIS

Jewish physicians in the Netherlands before 1600.

Hess, J. J. Die Sternbilder in HIOB 9_9 und 38_{31} f. *Festschrift Georg Jacob*, S. 94-99, Leipzig, HARRASSOWITZ, 1932. ISIS

14. — ISLAM

Macdonald, Duncan Black. The MACDONALD presentation volume. A tribute to DUNCAN BLACK MACDONALD, consisting of articles by former students, presented to him on his seventieth birthday, April 9, 1933. X+487 p., port., ills. Princeton, University Press, 1933. ISIS

Reviewed by GEORGE SARTON, *Isis* 21, 226, 1934.

Vieuchange, Michel. (1904-1930). Smara. Carnets de route de MICHEL VIEUCHANGE. Publiés avec une introduction, une postface et des appendices par JEAN VIEUCHANGE. Préface de PAUL CLAUDEL. Avec 53 gravures hors texte et une carte. XXVI+297 p. Chez les dissidents du sud Marocain et du Rio de Oro. Paris, PLON, 1932 (20 frs.). ISIS

Account of VIEUCHANGE's painful and heroic journey (Sept. 10 to Nov. 16, 1930) across the S.W. (Spanish) Sahara. With a map (1 : 500,000). G. S.

Vieuchange, Michel. Smara, the forbidden city : Being the journal of MICHEL VIEUCHANGE while travelling among the independent tribes of South Morocco and Rio de Oro. Translated from the French by FLETCHER ALLEN. Edited, with introduction and epilogue by JEAN VIEUCHANGE. XII+276 p. London, METHUEN, 1933. ISIS

PART III

SYSTEMATIC CLASSIFICATION

I. — SCIENCE IN GENERAL

16. — HISTORY OF SCIENCE

Archives of the history of science and technology. IV+350 p., ill. Publications of the Institute of the history of science and tech-

nology of the Academy of sciences of the USSR, series I, vol. 2, Leningrad, Academy of sc., 1934. ISIS

The first volume of the Archives was listed in *Isis* 21,440. The present volume still lacks abstracts in western languages; the table of contents gives German translations of the titles of the papers. Relevant articles are listed in the present Critical Bibliography. The book is printed on good paper, but still too high in price (unbound, 10 rbl., poorly bound, 11.5 rbl.). A. P.

Binoux. Prix Binoux 1933. *Isis* 21, 210, 1934. ISIS

Davis, Tenney L.; Goodwin, H. M. A history of the departments of chemistry and physics at the Massachusetts Institute of Technology (1865-1933). 35 p., illus. Cambridge, Mass. Inst. of Technology Press, 1933. ISIS

Reviewed by HÉLÈNE METZGER, *Archeion* 15, 466, 1933.

Lenard, Philipp. Great men of science. Transl. from the second German edition by H. STAFFORD HATFIELD. With a preface by E. N. DA C. ANDRADE. XVIII+389 p., 62 port. New York, MACMILLAN, 1933 ($ 3.00). ISIS

This eminent physicist, a Nobel laureate, and recipient of the FRANKLIN and RUMFORD medals, has applied his analytic talent to a revaluation of the progress of scientific discovery from the days of PYTHAGORAS to the debacle of the World War. While ostensibly dealing with only sixty-six great men of science, the author in reality relates the work of these selected ones with that of their predecessors and followers, so that the treatise is not restricted to a series of biographies but tends to trace the genesis of ideas as well. The title is, however, more catholic in scope than the contents which are almost wholly concerned with the physical sciences and their applications. The only great biologists included are LINNAEUS and DARWIN. The absence of PASTEUR is conspicuous. To the author ARISTOTLE was only an obvious symptom of degeneration, GALEN non-existent, the Arabian culture only a reflection, the Middle Ages always Dark, and biology in the main not rising to noticeable greatness comparable to that in the more exact sciences of the physical aspects of the universe. In spite of these lacunae the book is a superbly critical and exhaustive presentation of the evolution of the basic ideas in the field of physics and related aspects of chemistry and astronomy. C. A. K.

Paris. Cours et conférences de l'Institut d'histoire des sciences (1933-34). *Isis* 21, 210, 1934. ISIS

Redman, L. V.; Mory, A. V. H. The romance of research. VIII+149 p., 6 figs. New York, Appleton-Century, 1933 ($1.00). ISIS

This is a rapid survey of the applications of science to industry. It fills a gap in literature in that it is written from the historical rather than

technological point of view. It has an underlying philosophy that what man has done in the way of change in his physical environment can also be paralleled along social lines by the application of scientific methods of control. The chapters deal with the themes of the methods and viewpoints of research, the long climb to freedom of thought, the emergence of chemistry and physics, the capture of power, the early history of the applications of science to industry and health in the U.S.A., the efflorescence of discovery during the period of industrial expansion, the rise of modern physics and biology, the expansion in the development and use of materials and their complex interrelations in industry, the influences of new requirements upon the discovery and supply of new materials in industry, the prophetic aspect of research, and the obligation to advance it into new fields. C. A. K.

Riabouchinsky, Dimitry. Les rapports scientifiques entre la France et la Russie. *Revue générale des sciences* 45, 46-50, 1934. ISIS

Sarton, George. Science in the Renaissance. *The civilisation of the Renaissance*, p. 75-95. Chicago, University of Chicago Press, 1929. ISIS

Reviewed by M. GUKOVSKI, *Archives of the history of science and technology* 2, 317-18, Leningrad Acad. of Science 1934 (in Russian).

Sarton, George. Section of the history of science of the Carnegie Institution. Fifteenth annual report, for the period extending from July 1, 1932 to June 30, 1933. *Isis* 21, 5-7, 1934. ISIS

17. — ORGANIZATION OF SCIENCE

(Internal organization is meant, see Isis 1, 195. *For external organization, national or international, see section* 55).

Gruenberg, Benjamin C. Scientific education as a defense against propaganda and dogma. *Journal of Educational Method*, 8 p., Nov. 1925. ISIS

Gruenberg, Benjamin C. The chains of PROMETHEUS. *Scientific monthly*, 25, 504-10, 1927. ISIS

" While every increase of knowledge means an increase of power, it means also an increase of sorrow. This is not to say that ignorance is bliss, or that wisdom is folly. It is only to recognize that knowledge does inhibit action, does dampen enthusiasm, does increase the burden of care. It is not necessary to defend knowledge, or its modern equivalent, science. But it is necessary for us to understand something of its nature and its limitations, of its dangers and its implications, as well as some of its concrete products and applications."

Gruenberg, Benjamin C. Hypothesis and doctrine in science teaching. *School and Society* 37, 8 p., 1933. ISIS

"The best way for scientists to combat dogmatism and fundamentalism is by eliminating fundamentalism and dogmatism from their own teaching." "A wider and more thorough inculcation of the scientific or experimental method should qualify larger numbers to deal effectively with new problems by preparing us to be receptive to new hypotheses; and by preparing us to reëxamine old assumptions and concepts, since these would then be more extensively and more consistently used as hypotheses rather than as ultimate truths, fundamental and unalterable criteria against which all proposals have to be tested. That is, in so far as we assimilate the experimental method, we should become both more open-minded and more critical."

Gruenberg, Benjamin C. The diffusion and dissipation of learning. *Journal of Adult Education*, 3-18, April 1934. ISIS

II. — FORMAL SCIENCES (Knowledge of forms)

19. — LOGIC AND THEORY OF KNOWLEDGE

Devaux, Philippe. Le pragmatisme conceptuel de CLARENCE IRVING LEWIS. *Revue de métaphysique et de morale*, 105-41, 1934. ISIS

20. — MATHEMATICS

Archibald, R. C. History and bibliography of numerical integration of differential equations. *Scripta mathematica* 2, 188-89, 1934. ISIS

Karpinski, Louis. Mathematics and the progress of science. *Revue de l'Ecole d'Ingénieurs*, 772-76, Istanbul 1934. ISIS

Lecture delivered at the Turkish College of Engineering in Istanbul. English text with Turkish translation by SALIH MURAT. G. S.

Keyser, Cassius J. The nature of the doctrinal function and its role in rational thought. *Scripta mathematica* 2, 143-54, 1934 (concluded from 1933). ISIS

Keyser, Cassius Jackson. Mathematics and the question of cosmic mind. *Scripta mathematica* 2, 125-29, 1934. ISIS

Loria, Gino. Storia delle matematiche. Volume terzo ed ultimo dall' alba del secolo XVIII al tramonto del secolo XIX. 607 p. Torino, Sten, 1933. ISIS

Vols. 1 and 2 of LORIA's elaborate history have been reviewed in *Isis* 13, 228 and 19, 231. Vol. 3 dealing with the eighteenth and nineteenth centuries is even more valuable and interesting than the two earlier ones, because this synthesis is newer and the selection of topics necessarily more individual and more difficult. This third volume begins with the early development of the calculus and the controversies relative to Newtonian or Leibnizian priority and to the soundness of this new method. This volume is divided like the two preceding ones in 15 chapters; thus the whole work is divided in 45 parts, which might be the lectures of a course; a very well balanced course indeed except that the account of pre-Greek and Greek mathematics is I believe, too short on this scale. The contents of the present volume are : 31. Durante la grande contesa. I : Nella Svizzera tedesca; II : In Inghilterra. 32. I nuovi calcoli in Italia e in Francia. 33. La teoria delle probabilità nella sua prima fase di sviluppo. 34. L. EULER. 35. Contemporanei di EULER. 36. G. L. LAGRANGE. 37. Le matematiche durante la Rivoluzione francese, il Consolato e l'Impero. 38. La geometria verso una nuova rinàscita. I : Sulle orme degli antichi geometri; II : Prodromi di una metamorfosi nella geometria. 39. La Germania alla riscossa. I : Trattatisti e combinatori; II : C. F. GAUSS. 40. Orientamento dell'analisi verso procedimenti rigorosi, I : B. BOLZANO; II : A. L. CAUCHY; III : N. H. ABEL; IV : C. G. J. JACOBI. 41. Costituzione della fisica matematica. 42. Il periodo aureo della geometria projettiva; I : Ricerche geometriche; II : Ricerche analitico-geometriche; nuovi sussidi algoritmici. 43. Nuovi rami sul vetusto tronco. 44. L'analisi matematica de CAUCHY e JACOBI a POINCARE e G. CANTOR. 45. Gli storici. Appendice. Le matematiche nell'Estremo Oriente.

What a magnificent program which should attract and stimulate many readers ! This third volume will be indispensable to every teacher or student of the history of mathematics. With regard to nineteenth century mathematics, I beg to draw attention also to the series of biographies recently published in Benares (1933-34) by GANESH PRASAD and reviewed elsewhere (*Isis*, 22, 359-60, 575). G. S.

Mroček, V. R. Entstehung und Entwickelung der Wahrscheinlichkeitsrechnung. *Archives of the history of science and technology* 2, 45-60, Leningrad, Acad. of Sciences, 1934 (in Russian). ISIS

Richeson, A. W. Courses on the history of mathematics in the United States. *Scripta mathematica* 2, 161-65, 1934. ISIS

Rome, A. Histoire des mathématiques. *Revue des questions scientifiques* 27 p., septembre, 1933. ISIS

Sujets traités : 1. Arithmétique babylonienne; 2. Géométrie égyptienne; 3. Géométrie juive; 4. Sur l'invention de la boussole; 5. Géographie grecque; 6. La collection de PAPPUS; 7. Sciences romaines.

Sarton, George. The study of the history of mathematics. *American mathematical monthly* 41, 127-9, 1934. ISIS

Summary of SARTON's informal lecture at the joint session of the Mathematical Association of America with section of A.A.A.S. on Dec. 29, 1933.

Slaught, H. E. The lag in mathematics behind literature and art in the early centuries. *American mathematical monthly* 41, 167-74, 1934. ISIS

"The number concept and its development in algebraic science have caused the human race far greater trouble than the language concept and its development in literature; and the lag of mathematics behind literature was an inevitable consequence of the relative difficulties involved in these two concepts."

Wieleitner, Heinrich. (1874-1931). Zur Geschichte der quadrierbaren Kreismonde. Aus dem handschriftlichen Nachlass von Dr. HEINRICH WIELEITNER. Herausgegeben von Jos. E. HOFMANN. 74 p., 33 fig. Wissenschaftliche Beilage zum Jahresbericht des Neuen Realgymnasiums München für das Schuljahr 1933-34 (RM. 1.50). ISIS

This posthumous study of our lamented friend, the great historian of mathematics, HEINRICH WIELEITNER of Munich, deals with the history of the squarable lunules, a subject which had interested him since the time of his student days. He concluded:

"Wir haben den Versuch unternommen, einen Überblick über die mathematische Weiterentwicklung der Lunula-Probleme durch die Jahrtausende hindurch zu geben. Die Alten sahen in der Quadratur der luna quadrantalis nicht viel mehr als eine geistreiche Spielerei und beachteten die andern Quadraturen des HIPPOKRATES so wenig, dass diese für lange Zeit verschollen und unwirksam bleiben konnten. Erst VIÈTE versuchte über die luna quadrantalis hinaus weitere geschlossene Kreismöndchen zu bestimmen, die man unter Anwendung einfacher Konstruktionsmittel quadrieren kann. Das 18. Jahrhundert brachte den entscheidenden Ansatz von D. BERNOULLI, der aber zuviel fordert; er enthält eine hinreichende Bedingung, keine notwendige. Wenige Jahrzehnte später fand WIJNQUIST die wohlbekannten fünf Fälle quadrierbarer geschlossener Kreismöndchen, die bisher weder vermehrt noch als die einzig möglichen erkannt werden konnten. Klarheit über die Aufstellung einer notwendigen Bedingung konnte auch die moderne Untersuchung LANDAUS nicht geben, die einen grossen Fortschritt, aber keinen Abschluss in der Frage konstruierbarer geschlossener Kreismöndchen lieferte. Die offenen Möndchen treten uns erstmals bei LIONNE entgegen; sie haben um die Wende des 17. Jahrhunderts eine eingehende Behandlung erfahren. Der Kreis der lunula-Probleme bildet, historisch wie mathematisch gesehen, ein ziemlich geschlossenes Ganzes; wohl finden wir seit dem 18. Jahrhundert eine Fülle von neuen Einzelergebnissen vor, die unsere Erkenntnis verbreitern konnten, aber wesentlich neue Gesichtspunkte sind—abgesehen von der schönen Untersuchung LANDAUS—nicht zu Tage getreten."

Windred, G. History of mathematical time. *Isis* 19, 121-53; 20, 192-219, 1933-34. ISIS

Reviewed in *Nature* 133, 388, 1934.

Zeuthen, H. G. Istoriia matematiki v XVI i XVII vekakh. Translated from the German by P. NOVIKOV. Revised with notes and preface by M. I. VYGODSKI. 429 p., 16 pl. Moscow, State Technical-Theoretical Publ. Co., 1933. ISIS

This is one of a long list of treatises by well known scholars, translated into Russian and announced for publication in 1933. Among others there are treatises by the following authors : M. BÔCHER, H. A. BOHR, R. COURANT, T. C. FRY, É. J. B. GOURSAT, W. A. GRANVILLE, A. HURWITZ, L. OLSCHKI, H. B. PHILLIPS, A. G. WEBSTER and G. SZEGÖ, H. WEYL, E. T. WHITTAKER and G. N. WATSON, and H. K. WIELEITNER.

The Russian edition of ZEUTHEN's work is made from the German edition, *Geschichte der Mathematik im XVI und XVII Jahrhundert*, prepared by RAPHAEL MEYER in collaboration with the author and published, simultaneously with the Danish edition, in 1903. This was the continuation of ZEUTHEN's *Geschichte der Mathematik im Altertum und Mittelalter* (1896; Danish ed., 1893). In preparing his edition, Professor VYGODSKY found many parts of ZEUTHEN's work too brief to be in the most useful form for teachers. Such places he has expanded or revised in detail, but the general plan and various divisions of the work are unchanged. The extensive alphabetic index at the end has been preserved. In one respect there is an improvement in the Russian as compared with the German original. This is in the addition of sixteen full-page plate illustrations, twelve of them portraits. R. C. A.

III. — PHYSICAL SCIENCES
(Knowledge of inorganic nature)

23. — ASTRONOMY

Archibald, R. C. Porträt Gallerie der astronomischen Gesellschaft. *Scripta mathematica* 2, 176-78, 1934. ISIS

Brown, Basil J. W. Astronomical atlases, maps & charts. An historical & general guide. 200 p., 19 pl., frontispiece, London, Search, 1932. ISIS

Contents : General notes on the atlases, maps and charts of astronomy. 1. Early star-atlases and charts (APIANUS-HEVELIUS); 2. Star-atlases and charts (SELLER-WOOLSEY); 3. Star-atlases and charts (WOLLASTON-PROCTOR); 4. Star-atlases and charts (DUNKIN, to end of nineteenth century, supplementary twentieth century list); 5. Star catalogues with historical and other notes; part 1. General star catalogues; part 2. Catalogues of double stars, variable stars, red stars, nebulae and clusters. Early astronomical tables; 6. Solar and spectroscopic charts with notes on their history; 7. " The moon " —selenographic charts and their history; 8. Charting the planets (history and modern progress), etc. It is a pity that the author of this very interesting work did not keep it longer on the stocks. He has done only the beginning

of his task. The book is beautiful and this makes it the more regrettable that it is not better. No index. G. S.

Maunder, Annie S. D. The Gothic cycle or the Nakshatras. *J. Br. A. Ass.* 43, 121-5, 1933. ISIS

24. — PHYSICS

Burr, Alex. C. Notes on the history of the experimental determination of the thermal conductivity of gases. *Isis* 21, 169-86, 1934. ISIS

"Part I covers the developments in this field from the earliest experiments of PRIESTLEY, circa 1780, until the establishment of the thermal conducting power of gases by MAGNUS in 1860. Part II covers the important developments from the time of MAGNUS until the present time."

Clay, Reginald S. ; Court, Thomas H. The history of the microscope, compiled from original instruments and documents, up to the introduction of the achromatic microscope. XIV+266 p., 164 fig. London, GRIFFIN, 1932. ISIS

Reviewed by C. A. KOFOID, *Isis* 21, 227-30, 1934.

Congrès international d'électricité tenu à Paris en 1932. Treize volumes, 7167 p. Paris, GAUTHIER-VILLARS. ISIS

Volume 12 (11e section) : Electricité atmosphérique, magnétisme terrestre; (13e section) : Histoire de l'électrotechnique, enseignement, 644 p. Treizième section. Première sous-section : Histoire de l'électricité. J. BETHENOD (France). L'exposition internationale de l'électricité de 1881 et son influence sur le développement de la science et de la technique. O. VON MILLER (Allemagne). Les musées techniques allemands, une source féconde pour l'étude historique de l'électrotechnique. P. MEYER et F. NATALIS (Allemagne). Histoire de l'électrotechnique en Allemagne d'après les traités technico-littéraires et les comités spécialisés.

25. — CHEMISTRY, PHYSICO-CHEMISTRY, INDUSTRIAL CHEMISTRY

Kremers, Edward and colaborers. Phytochemistry. I. Introduction. *Bulletin of the University of Wisconsin*, serial no. 1732, 3-18, 1931. ISIS

Partington, J. R. The discovery of mosaic gold. *Isis* 21, 203-06, 1934. ISIS

History of *aurum musivum* (mosaic gold; crystalline stannic sulphide, SnS^2). The earliest recipe is the *De arte illuminandi* (a XIV Ms. of Italian origin). G. S.

Ruska, J. Sal Alembroth. *Festschrift Georg Jacob*, S. 234-40, Leipzig, HARRASSOWITZ, 1932. ISIS

Attempt to explain the origin of the old alchemical name of the double chloride of ammonium and mercury (al-ṭabarzad, al-barūd ?). G. S.

26. — TECHNOLOGY

(*For mining, see* 32. *geology* ; *for industrial chemistry*, 25. *chemistry. See also Arts and crafts under* 45)

Block, W. Die Entwicklung der neueren Uhrentechnik. *Beiträge zur Geschichte der Technik und Industrie* 22, 77-82, 5 fig., 1933. ISIS

Chandler, Charles Lyon. Early shipbuilding in Philadelphia, A.D. 1683-1812. The Newcomen Society, *Transactions* 12, 1931-32, 110-11, 1933. ISIS

Dickmann, H. Zur Geschichte des Eisens. *Beiträge zur Geschichte der Technik und Industrie* 22, 120-22, 1933. ISIS

Apropos of the Swedish book of CARL SAHLIN (Stockholm 1931).

Füchsel, Max. Die Technik und der Schweisser. *Beiträge zur Geschichte der Technik und Industrie* 22, 103-08, 1933. ISIS

Hennell, Thomas B. Men of straw : an account of surviving straw handicraft. The Newcomen Society, *Transactions* 12, 1931-1932, 15-29, 5 fig., 1933. ISIS

Horwitz, Hugo Th. Über das Aufkommen, die erste Entwicklung und die Verbreitung von Windrädern. *Beiträge zur Geschichte der Technik und Industrie* 22, 93-102, 1933. ISIS

Ostertag, R. von. Beiträge zur Geschichte der Lebensmittelkonservierung. *Beiträge zur Geschichte der Technik und Industrie* 22, 87-92, 4 pl., 1933. ISIS

Scott, E. Kilburn. Early cloth fulling and its machinery. The Newcomen Society, *Transactions* 12, 1931-1932, 31-52, 6 fig., 1933. ISIS

Strumilin, S. G. Fortschritte der Technik in den letzten 3 Jahrhunderten. *Archives of the history of science and technology* 2, 81-104, Leningrad, Acad. of Sciences, 1934 (in Russian). ISIS

Tanzer, Karl. Wegbereiter der oberschlesischen Industrie. *Beiträge zur Geschichte der Technik und Industrie* 22, 44-56, 2 pl., 1933. ISIS

Technik Geschichte. Im Auftrage des Vereines Deutscher Ingenieure hrsg. v. CONRAD MATSCHOSS. *Beiträge zur Geschichte der Technik und Industrie*, Bd. 22, VII+156 p., 28 pl., Berlin, 1933. ISIS

The very rich contents of this volume are analyzed in the present bibliography. (By the way, every volume of these Beiträge has been analyzed in our Critical bibliographies which thus include a general index to that important series). The only parts of this volume which are not analyzed are the two interesting departments entitled Technische Kulturdenkmale (pls. 23-24, p. 138-41) and Technik in Museen (p. 142-56, pl. 25-28). G. S.

IV. — BIOLOGICAL SCIENCES
(Knowledge of organic nature)

27. — BIOLOGY (*generalities, "Natural history"*)

Bauverie, J. La systématique des formes. Les grandes étapes du progrès de la classification naturelle, ses tendances actuelles. 64 p., ill. Paris, Les Edit. du Cerf (s.d. 1932). ISIS

Färber, Eduard. Stoff und Form als Problem der biochemischen Forschung. Eine geschichtliche Betrachtung. *Isis* 21, 187-202, 1934. ISIS

Whitehead, George. A modern outline of evolution. VIII+324 p. London, BALE, Sons and DANIELSSON, 1933 (7/6). ISIS

This is a popular presentation of inorganic and especially of organic evolution. It is very evidently based on a considerable familiarity with the general literature of biology in widely divergent lines. It is full of historical references to ideas, opinions, and data bearing on the evolutionary process. The author is, unfortunately, not always exact in citation. Sometimes he is uncritical in acceptance of data which seem to meet a need in his discussion, as for example, in the use of KAMMERER's discredited data on the inheritance of color changes in salamanders. C. A. K.

28. — BOTANY (*Agronomy, phytopathology, palaeobotany*)

Flachsberger, K. Kulturpflanzen der prähistorischen Periode. *Archives of the history of science and technology* 2, 165-78, 4 fig., 1934 (in Russian). ISIS

Lippmann, Edmund O. von. Nachträge und Ergänzungen zu der

Festschrift: Geschichte der Rübe (Beta) als Kulturpflanze. *Zeitschrift des Vereins der Deutschen Zucker-Industrie* 84, technischer Tl., 67 p., 1934. ISIS

Rübel, Eduard. Geographie der Pflanzen. Handwörterbuch der Naturwissenschaften, 2te Auflage, 1044-71, Jena, FISCHER, 1933. ISIS

Schmid, Günther. Carlina (Karlsdistel) und die Karlslegende. Kritische Beiträge zur Geschichte des Mittelalters. *Festschrift für Robert Holtzmann zum sechzigsten Geburtstag*, 221-51, 1933. ISIS

Stevens, Neil E. Plant pathology in the penultimate century. *Isis* 21, 98-122, 1934. ISIS

"This review of plant pathology in the eighteenth and early nineteenth centuries is confined to this country and those Western European countries from which the United States of 1833 chiefly derived its people and its culture. There is, however, no indication that the account would be greatly changed if a review were made of the knowledge of plant diseases found in oriental authors or writers of classic or medieval Europe, since there is little evidence that this early learning had penetrated into the agricultural information and practice of the century now under consideration. The close association of Mycology and Plant Pathology since the days of the TULASNE Brothers, DE BARY, and M. J. BERKELEY leads to the too frequent impression that plant pathology developed solely as a branch of mycology. Actually, it had a considerable independent history prior to the middle of the last century, in which mycology played little part."

Zirkle, Conway. More records of plant hybridization before KOELREUTER. *Journal of heredity*, 25, 18 p., 3 fig., 1934. ISIS

ZIRKLE's previous study on the same subject was fully reviewed in *Isis* 21, 218-20. The results of the present one are: "1. A number of documents describing instances of plant hybridization before KOELREUTER (some hitherto unpublished) are here reproduced and made available to modern geneticists. 2. Different colored grains on the same ear of corn were observed and described long before their significance was recognized. This occurrence has been recorded by TABERNAEMONTANUS (1588), MATTHIOLA (1590), GERARD (1597), a New England Journal (1620), BAUHIN (1620), LAET (1633), WINTHROP (1678), BEVERLY (1705), SALMON (1710) and MORISON (1715). 3. COTTON MATHER described hybridization in *Zea* and *Cucurbita* in a letter to JAMES PETIVER dated September 24, 1716. The letter is printed in full. 4. The actual finding of the *Dianthus* hybrid by THOMAS FAIRCHILD was described by PATRICK BLAIR in 1720. 5. RICHARD BRADLEY described hybridization in *Auricula (Primula)* in 1717 and discussed the effect of foreign pollen upon several varieties of apples and melons. 6. WILLIAM KNOWLTON observed hybridization in *Dianthus*. Our earliest record of this hybrid is 1720. 7. The Rev. Mr. THOMAS HENCHMAN observed hybridization in Pisum in 1729.

He was especially interested in the occurrence of different colored peas in the same pod. 8. Mr. BENJ. COOKE described variety crosses in *Zea Mays* in 1749. Four years earlier he discussed cross pollination in different varieties of apples. 9. Twelve different investigators have been found who described plant hybridization before KOELREUTER reported his classical experiments. With the possible exceptions of FAIRCHILD and LINNAEUS, they were all extremely casual in their researches and seemed to have been content with describing what they found without resorting to designed experiments. In spite of this, plant hybridization was well understood in 1761."

29. — ZOOLOGY

Samojlovic, A. Beiträge zur Bienenzucht in der Krim im 14.-17. Jahrhundert. *Festschrift Georg Jacob*, S. 270-75, Leipzig, HARRASSOWITZ, 1932. ISIS

V. — SCIENCES OF THE EARTH
(Implying knowledge of both organic and inorganic nature)

31. — GEOGRAPHY AND OCEANOGRAPHY

Enderes, Bruno V. Die Geschichte der Alpenstrassen und Alpenbahnen. *Beiträge zur Geschichte der Technik und Industrie* 22, 7-17, 4 pl., 1933. ISIS

Sykes, Sir Percy. A history of exploration from the earliest times to the present day. XIV+374 p., 25 pl. London, ROUTLEDGE, 1934. ISIS

32. — GEOLOGY, MINERALOGY, PALAEONTOLOGY, MINING
(For palaeobotany, palaeozoology and palaeoanthropology, see respectively 28. *botany*, 29. *zoology and* 39. *prehistory)*

Margerie, Emmanuel de. La géologie. P. 199-267 (La science française, Nouvelle édition entièrement refondue). Paris, Librairie Larousse (no date, received in April 1934). ISIS

History of French geology by a master of the subject. Abundant bibliography. G. S.

Petrovskij, A. A. Evolution der geophysikalischen Schürfungsmethoden. *Archives of the history of science and technology* 2, 61-80, 12 fig. Leningrad, Acad. of Sciences, 1934 (in Russian). ISIS

VI. — ANTHROPOLOGICAL AND HISTORICAL SCIENCES
(Knowledge of man, past and present)

34. — ANATOMY

Costa, A. Celestino da. L'histologie et l'embryologie à la Faculté de médecine de Lisbonne. *Arquivo de anatomia e antropologia* 15, 537-46, illus., Lisbon, 1932-1933. ISIS

Sueiro, M. B. Barbosa; Fontes, Victor. Aperçu historique de l'enseignement de l'anatomie humaine à Lisbonne. *Arquivo de anatomia e antropologia* 15, 489-520, illus. Lisbon, 1932-1933. ISIS

Vilhena, H. de. Aperçu de l'œuvre de l'Institut d'anatomie de Lisbonne. *Arquivo de anatomia e antropologia* 15, 521-36, Lisbon, 1932-1933. ISIS

39. — PREHISTORY

Riesman, David. Man before the dawn of history. *Scientific monthly* 37, 553-62, 1933. ISIS

40. — ETHNOLOGY (*Primitive and popular science*)

Marinus, Albert. Folklore et science. 50 p., figs. *Le Folklore Brabançon*, 13, 1933. ISIS

Sarton, George. Primitive tonsillotomy. *Query* no. 40. *Isis* 21, 209, 1934. ISIS

Wright, Jonathan. Medicine of primitive man—XXIII. *Medical life* 41, 32-41, 1934. ISIS

42. — ECONOMICS
(*Economic doctrines and history, commerce. Transportation and communications*)

Schulte, Aloys. Über spätmittelalterliche Verkehrstechnik. Vorwiegend nach den Papieren der grossen Ravensburg-Konstanzer Handelsgesellschaft. *Beiträge zur Geschichte der Technik und Industrie* 22, 18-24, 1933. ISIS

43. — SOCIOLOGY, JURISPRUDENCE AND POSITIVE POLITY

Fisher, R. A. The social selection of human fertility. 32 p. (The Herbert Spencer lecture delivered at Oxford, June 8, 1932). Oxford, Clarendon Press, 1932 (*s.* 70). ISIS

This lecture summarizes physical determinism from LAPLACE to BOLTZMANN and JEANS, and then discusses the application of the laws of causation in the social sciences. He concludes that in both the physical and social sciences a keener foresight and a higher precision in the fulfillment of our plans is attainable by increased knowledge and sharper attention to relevant details. Calculable reactions in physics are attainable where the units are independent, the volume big enough, and the units not too highly organized. In human society organization limits the independence of behavior of the units. Public opinion is influenced by eloquence and propaganda. In social phenomena subject to these two factors the independence of the units is lost, or, at the best, highly modified. Human inheritance, however, retains this independence in its multitudinous units. Natural selection has diverted attention from the selective birth rate to the selective death rate. The lowering of the birth rate is correlated with the social awards of promotion, and this, perhaps in a relatively short time, tends to displace the promoted class in so far as the qualities inducing promotion fall into the hereditary category. Both promotion and birth rate are subject to control. C. A. K.

44. — HISTORY OF CIVILIZATION

(*General history, historical methods, biography and chronology*)

International bibliography of historical sciences (Internationale Bibliographie der Geschichtswissenschaften). Third year 1928. Fourth year 1929. Edited by the International Committee of historical sciences, Washington (U.S.A.), Paris, Berlin, Rome, London, New York, 1933. CVII+459 p.; CVII+495 p. ISIS

Reviewed by HEINRICH SPROEMBERG, *DLZ* 5, 126-31, 1934.

Leland, Waldo G. Recent trends in the humanities. *Science* 79, 281-85, 1934. ISIS

Address of the retiring vice-president and chairman of Section L—Historical and philological sciences, American Association for the Advancement of Science, Boston, December 1933.

List of research projects in history, exclusive of doctoral dissertations, now in progress in the United States and the Dominion of Canada, 54 p. *American Historical Review* (supplement to vol. 39, no. 3. 1934.). ISIS

48. — HISTORY OF PHILOSOPHY

(*See also above* 18. *Philosophy of science*)

Benrubi, J. Les sources et les courants de la philosophie contemporaine en France. 2 vol., VIII+1058 p. Paris, ALCAN, 1933. ISIS

VII. — MEDICINE

50. — HISTORY, ORGANIZATION, AND PHILOSOPHY OF MEDICINE

Behnke, Helen Duncan. Colonial theories concerning the cause of disease. *Medical life* 41, 59-74, 1934. ISIS

Clendening, Logan. Behind the doctor. With illustrations from contemporary sources, portraits, photographs, and original drawings by JAMES E. BODRERO and RUTH HARRIS BOHAN. New York, KNOPF, 1933. ISIS

Reviewed in *Annals of Medical history* 6, 189, 1934.

Diepgen, Paul. Kurpfuscherei und wissenschaftliche Medizin im Wandel der Zeiten. *Gesundheitslehrer*, Ausgabe A, 6 S., July, 1933. ISIS

Diepgen, Paul. Das Schicksal der deutschen Medizingeschichte im Zeitalter der Naturwissenschaften und ihre Aufgaben in der Gegenwart. *Deutsche Medizinische Wochenschrift*, Nr. 2, 12 p., 1934. ISIS

Guiart, Prof. Les historiens de la médecine à Lyon. *Bull. de la soc. franç. d'hist. de la méd.* 27, 351-68, 6 fig., 1933. ISIS

Hirsch, August. Biographisches Lexikon der hervorragenden Ärzte aller Zeiten und Völker. Zweite Auflage durchgesehen und ergänzt von W. HABERLING, F. HÜBOTTER und H. VIERORDT. Dritter Band, HAAFF-LYSONS. Mit 64 Bildnissen. 873 p. Berlin, URBAN & SCHWARZENBERG, 1931. (RM. 75. geh., 82.50 geb.). ISIS

The new edition of this standard work of medical biography began to appear in 1929 and the first two volumes were reviewed in *Isis* 14, 565; 15, 314. The third volume contains 64 portraits on 16 plates. The remarks made apropos of the first two volumes need not be repeated. It will suffice to say that this is an indispensable book of reference. G. S.

Hurd-Mead, Kate Campbell. Medical women of America. A short history of the pioneer medical women of America and of a few of their colleagues in England. 95 p., ills. New York, Froben Press, 1933 ($1.). ISIS

The author of this book has taken great pains to publish as full and fair an account as possible. Her story is followed by a fine series of portraits and is well indexed. G. S.

Rolleston, Sir Humphry. The progress and pioneers of preventive medicine. *Annals of medical history* 6, 95-109, 1934. ISIS

Thiessen, Norman W. An outline of the development of concepts of humoral medicine. *Medical life* 41, 3-19, 1934. ISIS

(Warsaw). La médecine au Congrès de Varsovie (21-28 août 1933). Par M. Fosseyeux. *Bull. de la soc. franç. d'hist. de la méd.* 27, 325-40, 1933. ISIS

51. — EPIDEMIOLOGY, HISTORY OF SPECIAL DISEASES. PUBLIC HEALTH AND SOCIAL MEDICINE

Bett, W. R. A short history of some common diseases. By divers authors. VII+211 p. (Oxford medical publications). London, Oxford University Press, 1934. ISIS

Lint, J. G. de. Syphilis en Framboesia. *Bijdragen tot de geschiedenis der geneeskunde* 14, 31-32, 1934. ISIS

52. — HISTORY OF HOSPITALS, OF MEDICAL TEACHING, AND OF THE MEDICAL PROFESSION

Philadelphia hospitals. Old Blockley. Proceedings of the bicentenary celebration of the building of the Philadelphia almshouse. 171 p. New York, Froben Press, 1933 ($ 1.). ISIS

Reprint in book form of a series of 23 articles published in *Medical Life*. Abundant illustrations. Every aspect of the Philadelphia General Hospital is considered, each one being discussed by an expert. G. S.

VIII. — EDUCATION

(The methods of accumulating, imparting and diffusing knowledge)

54. — EDUCATION (*Generalities, methods, colleges, universities*)

Turner, A. Logan. History of the University of Edinburgh, 1883-1933.

Edited in behalf of the History Committee by A. LOGAN TURNER. XXXVI + 452 p., 27 pl., Edinburgh, OLIVER and BOYD, 1933. (10 sh.).

ISIS

This history celebrates the 350th anniversary of the founding of the University of Edinburgh. It opens with an account of the origin of the institution, followed by sections on administration, on the faculty of divinity, and on that of law. The account of the Faculty of Medicine is by J. D. COMRIE, with sections on the several departments, on tuberculosis, child life, teaching of women in medicine, and post-graduate work. Special note is made of the leadership of the University in anatomy, and of the work of Lord LISTER. Portraits of Sir WM. TURNER and of Lord LISTER are included. The Faculty of Science was not established until 1893, although the subject had been ably represented in earlier years by HUTTON, PLAYFAIR, FORBES, GEIKIE, BREWSTER, BALFOUR, ALLMAN, EWART, WYVILLE THOMSON, and TURNER. The histories of the departments of botany, natural philosophy, zoology, astronomy, agriculture, forestry, chemistry, engineering, geology, mining, and animal genetics are written by professors in these departments, and include in their scope the entire development of these subjects in the institution. Chemistry and the biological sciences crept into the University as subsidiaries of medicine, and were slow in acquiring academic status alongside those established in the Faculty of Arts. There is a chapter on the library and one on the University portraits, notably the RAEBURNS.

C. A. K.

55. — ACADEMIES, SOCIETIES, CONGRESSES, NATIONAL AND INTERNATIONAL ORGANIZATION OF SCIENCE

(*Societies and congresses devoted to particular sciences are classified under those sciences. For the internal organization of science*—Isis I, 195—*see section* 17)

Rübel, Eduard. Eine allgemeine schweizerische Akademie und die bestehende Naturforscher-Akademie. *Neue Schweizer Rundschau*, 15 p., Februar 1934. ISIS

57. — MUSEOLOGY (*Museums and collections*)

Adams, Charles C. The proposals for a new state museum building. *New York State Museum Bulletin* 293, 81-110, Albany, 1932. ISIS

Hannan, William E.; Lambert, June. The development of the New York State museum as provided by the laws of New York State, 1836-1931. *New York State Museum Bulletin* 293, 59-80, Albany, 1932. ISIS

Matschoss, Conrad. Die Heimatmuseen und die Technik. *Beiträge zur Geschichte der Technik und Industrie* 22, 6 p., 1933. ISIS

58. — CATALOGUES OF SECOND-HAND BOOKS ON THE HISTORY AND PHILOSOPHY OF SCIENCE

Many catalogues of second-hand books are so interesting and so full of valuable information that we shall henceforth register them in this section, together with other lists of a similar nature, such as catalogues of scientific medals and prints. When applying to the publishers of these catalogues for a copy, please mention *Isis*.

Fock, Gustav. Mathematik. Enthaltend die besonders an seltenen mathematischen Büchern des 15. bis 18. Jahrhunderts Reichhaltige Bibliothek des Geh. Rats Prof. Dr. A. PRINGSHEIM-MÜNCHEN. Antiquariatskatalog Nr. 689, 148 p. Leipzig C 1, Schlossgasse 7, (received February 1934). ISIS

Junk, W. Periodica, iconographiae, rara et curiosa. Catalogue no. 85, 62 p. Berlin W. 15, Sächsische Str. 68, 1934. ISIS

Junk, W. Scientia naturalis ante annum 1800. Historia (et Bibliographia) Catalogue no. 84. 60 p. Berlin W. 15, Sächsische Str. 68, 1934. ISIS

Laffitte, Louis. Voyages, Afrique, Asie, Amérique, Océanie, Marine. Catalogue no. 65, 5522 items. Marseille, 1, Boulevard Garibaldi, 1932. ISIS

Quaritch, Bernard. A catalogue of books & periodicals on botany. Including a large selection from the libraries of the late Prof. WILLIAM GRANT CRAIB, Regius professor of botany in the University of Aberdeen and the late Dr. OTTO STAPF, keeper of Herbarium and library, Royal Botanic Gardens, Kew, No. 485, 837 items, 64 p. London, W.1, 11 Grafton St., New Bond St., 1934. ISIS

Quereuil, J. A. Mémoires, recits historiques, histoire des provinces, voyages etc. etc. 81 p., 2078 items, Paris, (VI[e]), 35-37 rue Bonaparte, 1934. ISIS

59. — MEMORIA TECHNICA

Isis no. 60 (vol. 21, 1-230, 10 pl., 8 fig.) Bruges, 1934. ISIS

This number is analyzed in the forty-first Critical Bibliography. Every previous number has been analyzed in previous bibliographies. G. S.

Critical bibliography no. 41, *Isis*, vol. 22, 557-613. ISIS

This note is published at the end of our bibliography solely for the con-

venience of the scholars who cut out the whole or part of it, attach extracts to catalogue cards and classify them. By adding this note to the others they will be able to find out rapidly whether this particular bibliography has been analyzed. G. S.

60. — **ERRATA.** Series 31.

(*For previous* errata *see* Isis, 22,422.)

Vol. 17, 159, suppress footnote 2.
161, l. 6, Plato 3 (not 1).

A few other misprints are not mentioned in these errata because they are too obvious to cause any error or confusion. I wish to express my thankfulness to the readers who take the trouble to make the above-mentioned corrections in their set of *Isis* and the *Introduction*. I would advise them, after having accomplished that little task, to write their initials near mine at the bottom of this note to indicate that these and the previous errata have been taken into account.

These and the previous errata have been corrected by...

Index of Authors Included in the Forty-First Bibliography

The Roman figures followed by (1) or (2) refer to the centurial classification (Part 1). Thus, Andel, M. A. van, XVII(1)D means that a paper by van Andel is listed under seventeenth century, first half, subdivision D.

The Arabic figures refer to the historical and to the systematic classification (Parts II and III) which are subdivided in sections numbered consecutively from 1 to 60. For instance, Diepgen, P., 5, 50, indicates that papers by Diepgen are listed in section 5 (Rome), and in section 50 (History of medicine).

May 1934. FRANCES SIEGEL.

A

Adams, C. C., 57.
Adler, E. N., 12.
Almeida, J. J. de, XX C.
Andel, M. A. van, XVII(1)D.
Antoniadi, E. M., 2.
Archibald, R. C., 20, 23.
(Archives of the hist. of sci. and tech.), 16.
Arkell, W. J., 1.
Azevedo, J. L. de, XIX(2)E.

B

Baidaff, B. I., XVIII(1)A.
Bailey, C., 5.
Barge, J. A. J., XVIII(1)D.
Bartolomeus Anglicus, XIII(1).
Battistini, M., XVII(1)B.
Bauman, E. D., V B.C.
Baumgartner, L., XVIII(2)D.
Baumgartner, W., 12.
Bauverie, J., 27.
Behnke, H. D., 50.
Benrubi, J., 48.
Berthelot, A., 4.
Berzelius, J., XIX(1)B.
Bessmertny, B., XVIII(2)E.
Bett, W. R., 51.
Beyerman, J. J., XVII(2)D.
Bidez, J., XX E.
Bignone, E., I(1)B.C.
(Binoux), 16.
Bloch, M. A., XX B.
Block, W., 26.
Bögel, K., 4.
Bosch, F., 4.
Boulanger, A., 4.
Boutaric, A., XX E.
Bragman, L. J., XIX(2)D.
Brasch, F. E., XIX(2)B.

Brodier, L., XVII(1)D.
Brown, B. J. W., 23.
Brown, G. B., 5.
Buckland, W. W., 5.
Büttner, H., 4.
Burn, A. R., 5.
Burr, A. C., 24.

C

(Camb. ancient hist.), 5.
Cantarella, R., 6.
Carbonelli, G., XX D.
Carcopino, J., I (1)B.C., 5.
Carpenter, R., 4.
Cary, M., 4.
Casson, S., 4.
Chandler, C. L., 26.
Chapman, J., XVIII(2)D.
Chaucer, G., XIV(2).
Ciaceri, E., 5.
Ciccotti, E., 5.
Claas, W., XVIII(2)B.
Clarke, F. M., XVIII(1)A.
Clay, R. S., 24.
Clendening, L., 50.
Cohen, D. E., 12.
Colman, E., XIX(1)A.
(Cong. inter. d'élect.), 24.
Corte, M. de, IV(2)B.C.
Costa, A. C. da, 34.
Court, T. H., 24.
Cowles, T., XVII(2)C.
Cumont, F., 4.

D

Dain, A., II(1).
Datta, B., 9.
Davis, T. L., 16.
Davis, W. M., XIX(2)C.
Dawson, W. T., XVIII(2)D.
Delatte, A., 7.
Devaux, P., 19.
De Vries, H., XVIII(1)A.
Dickinson, H. W., XIX(1)B.
Dickmann, H., 26.
Diepgen, P., 5, 50.
Dijksterhuis, E. J., 5.
Dittrich, P., 4.
Dobell, C., XVII(2)C.
Dölger, F., XIV(2).
Dominke, H., XIX(2)B.
Drachmann, A. G., I(1)B.C.
Drewitt, F. D., XVIII(2)C.

E

Ebeling, A., 5.
(Ecole franç. de Rome), 5.
Edgar, I. I., XVI(2)D.
Edgar, J. H., 10.
Enderes, B. V., 31.
Englert, L., XVI(1)D.

F

Fabricius, K., 4.
Färber, E., 27.
Faraday, M., XIX(1)B.
Feyerabend, E., XIX(1)B.
Finlayson, XIX(2)B.
Fisher, R. A., 43.
Flachsberger, K., 28.
Fock, G., 58.
Fontes, V., XX D, 34.
Forrer, R., 5.
Frazer, Sir J. G., XIX(2)E.
Friedenwald, H., XIX(1)D.
Füchsel, M., 26.
Furber, H., XVIII(2)B.

G

Gagnér, A., 5.
Garboe, A., XVIII(2)C.
Garosi, A., XV(1).
Geffcken, J., 4.
Gernet, L., 4.
Gervais, A., 10.
Getman, F. H., XIX(2)B.
Giordano, D., XVI(2)D, XVIII(2)D.
Goodwin, H. M., 16.
Goossens, R., 1.
Grabmann, M., XIV(1).
Grenier, A., 5.
Gross, A. T., XIX(2)B.
Gruenberg, B.C., 17.
Gudmund, B., 4.
Guiart, Prof., 50.

H

Haberling, W., XVIII(2)D.
Hagstroem, K. G., 4.
Halkin, L., XIX(2)E.
Hallema, A., XIX(1)D.
Hamilton, G., H. XIV(1).
Hannan, W. E., 57.
Hartmann, L., XIX(1)B.
Hartung, E. F., XIII(1).
Head, J. R., XVI(2)D.
Heath, Sir T. L., 4.
Heidel, W. A., 4.
Helmont, J. B. van, XVII(1)E.
Hennell, T. B., 26.
Herzog, R., 4.
Hess, J. J., 12.
Higger, M., XIII(1).
Hiller, J. E., XVII(2)C.
Hirsch, A., 50.
His, W., XIX(2)D.
Hofmann, J. E., III(2)B.C.
Hooreman, F., XX B.
Horn-d'Arturo, G., XVIII(1)B.
Horwitz, H. T., XIX(1)B, 26.
Howarth, E. K., XIX(2)C.
Howarth, O. J. R., XIX(2)C.
Hummel, A. W., 10.
Hutchison, R., XVIII(2)D.
Huygens, C., XVII(2)A.

I

Iašnov, P., XVII(1)B.
(International bib. of hist. sciences), 44.

J

Jacob, G., XX E.
Jenkins, R., XIV(1).
Johannsen, O., XVIII(1)B.
Jolowicz, H. F., 5.
Josserand, C., 7.
Junk, W., 58.

K

Karpinski, L., 20.
Keyser, C. J., 20.
Kieckers, E., 5.
Klebs, A. C., XVII(1)C.
Krause, A. C., 3.
Kremers, E., 25.
Krilov, A. N., XVIII(1)A., XX B.
Kurzel-Runtscheiner, E., XVIII(1)B.

L

Laffitte, L., 58.
Lalou, M., 9.
Lambert, J., 57.
Larkey, S. V., XVII(2)D.

Leland, W. G., 44.
Lenard, P., 16.
Licht, H., 4.
Lietzmann, W., 4.
Linossier, R., XX E.
Lint, J. G. De, 1, 51.
Lippmann, E. O. v., I(1)B.C., XIX(1)B, 1, 27.
(List of research projects in hist.), 44.
Listmann, K., 4.
Loeschmann, A., 5.
Lorey, W., XVIII(1)A.
Loria, G., 9, 20.
Luria, S., 4.

M

MacBride, E. W., XIX(2)C.
Macdonald, D. B., 14.
Macdonald, Sir G., 5.
Majuri, A., 5.
Marconi, E., XVII(1)D.
Margerie, E. de, 32.
Marian, V., XVIII(1)B.
Marinus, A., 40.
Marotte, F., 4.
Mason, W. W., XIX(1)B.
Maspero, H., 10.
Matschoss, C., 57.
Mauclaire, N. A., XVIII(1)D.
Maude, A., XX C.
Maunder, A. S. D., 23.
McDowell, E., XIX(1)D.
Mengeringhausen, J., I(1)B.C.
Mengeringhausen, M., I(1)B.C.
Meyer, E., 1.
Meyerhof, M., 4.
Miller, A. H., XIX(1)B.
Miller, W., XV(2).
Millosevich, F., 5.
Minkowski, H., XVII(1)D.
Mönch, W., XVI(1)D.
Morse, W. R., 10.
Mory, A. V. H., 16.
Mountford, J. F., 4.
Mroček, V. R., 20.
Müller, R. F. G., 9.
Mžik, H. v., 6.

N

Nasini, R., 5.
Neumark, S., XIX(1)A.
Neville, E. H., XVII(2)A.
Nicolas de Cusa, XIV(2).
Nierenstein, M., XV(2), XIX(1)B.
Nordenmark, N. V. E., XVIII(1)B.

O

Ostertag, R. v., 26.

P

Packard, F. B., XVIII(1)D.
(Paris), 16.
Partington, J. R., 25.
Payne, H., 4.
Peate, I. C., 6.
Pelliot, P., VII(1).
Petrovskij, A. A., 32.
(Phil. hospitals), 52.
Picard, E., XVII(1)E.
Pinkhof, H., XVII(2)D.
Pirenne, H., 6.
Piwowarsky, E., 1.
Pleadwell, F. L., XVIII(2)D.
Prasad, G., XIX(2)A.
Preisendanz, K., 4.
Price, F. M., XV(2).
Prout, W., XIX(1)B.
Procissi, A., XVII(2)A.
Puech, H. C., II(2).

Q

Quaritch, B., 58.
Quereuil, J. A., 58.
Quiring, H., 1.

R

Radovskij, M. J., XVIII(2)B.
Ramsey, E. M., XVIII(2)D.
Redman, L. V., 16.
Reinach, S., XIX(2)E.
Rey, A., 4.
Riabouchinsky, D., 16.
Richeson, A. W., 20.
Richardson, B. E., 4.
Richter, G. M. A., 4.
Riesman, D., 39.
Rolleston, Sir H., 50.
Rome, A., 4, 20.
Rostand, J., XX E.
Rübel, E., 28, 55.
Ruska, J., XI(1), 25.
Rutherford, Lord, XX B.
Rynin, N. A., XX B.

S

Samojlovic, A., 29.
Sampson, R. A., XIX(2)B.
Sandford, K. S., 1.
Sarton, G., IX B.C., XVI(2)A, 16, 20, 40.
Schiller, L., XIX(1)B.
Schmid, G., XVIII(2)C, 28.
Schnabel, T. G., XIX(2)D.
Scholz, R., XIV(1).
Schulte, A., 42.
Scott, E. K., 26.
Sergescu, P., XX E.
Sheldon, G., 5.
Simon, F., 4.
Simons, L. G., XVIII(1)A.
Slaught, H. E., 20.
Smith, D. E., XVIII(2)B.
Solovjev, M., XVII(1)C.
Stapleton, H. E., XIV(2), 9.
Stenzel, J., 4.
Stevens, N. E., 28.
Strumilin, S. G., 26.
Styger, P., 5.
Suden, L. T., XVII(2)D.
Sudhoff, K., XIX(2)D.
Sueiro, M. B. B., 34.
Sulzberger, M. R., V B.C.
Sykes, Sir P., 31.

T

Tanzer, K., 26.
(Techn. Gesch.), 26.
Testi, G., 5.
Thiessen, N. W., 50.
Thompson, D. V., jr., XIV(1), XV(2).
Thorndike, L., XVII(2)D, 6.
Thureau-Dangin, F., 3.
Tillyard, H. J. W., 7.
Titley, A., XIX(1)B.
Tschanter, E., XIX(2)B.
Turner, A. L., 54.

V

Vera, F., 6.
Verschaffel, A., XIX(2)B.
Vieuchange, M., 14.
Vilhena, H. de, 34.
Voglianio, A., IV(2)B.C.
Vollgraff, W., 4.
Vorobyev, A. G., XX B.

W

Wace, A. J. B., 4.
Waley, A., XI(2).
Walker, W. C., XVIII(2)B.
Walsh, J., II(2).
(Warsaw), 50.
Watson, G. N., XIX(1)A.
Weiss, E. A., XIX(2)A.
Wellmann, M., XIX(2)D.
Wheeler, R. E. M., 5.
Whitehead, G., 27.
Whittick, G. C., 5.
Wieleitner, H., 20.
Wilamowitz-Moellendorff, U. v., 4.
Windred, G., 20.
Wollaston, M., XIX(2)C.
Worsfold, Sir T. C., 5.
Woyciechowsky, J. v., XVIII(2)A.
Wright, J., 39.

Z

Zeitlin, E., XVII(1)B.
Zeuthen, H. G., 20.
Zirkle, C., XVIII(1)C, 28.
Zuretti, C. O., 4.

Brief Table of Contents of Vol. XXII (1934-1935)

622 p., 21 pl., 20 p. facsimile

E. W. GUDGER.—The five great naturalists of the XVIth Cent. : BELON, RONDELET, SALVIANI, GESNER and ALDROVANDI . . 21

W. A. HAMOR.—DAVID ALTER and the discovery of spectrochemical analysis. 507

C. D. HELLMAN.—A bibliography of tracts and treatises on the comet of 1577 41

A. G. KAPP.—Arabische Übersetzer und Kommentatoren EUKLIDS, sowie deren math.-naturw. Werke auf Grund des *Ta'rikh al-hukama* des IBN AL-KIFTI. (1) 150

L. C. KARPINSKI.—Importance of the Greek algebraical problems 104

R. S. MARX.—A XIIIth Cent. theory of heat as a form of motion 19

J. R. PARTINGTON.—Chemical arts in the mount Athos manual of Christian iconography 136

C. H. PEAKE.—Some aspects of the introduction of modern science into China. 173

B. PETRONIEVICS.—Über LEIBNIZens Methode der direkten Differentiation 69

A. POGO.—GEMMA FRISIUS, his method of determining differences of longitude by transporting timepieces (1530), and his treatise on triangulation (1553) 469

F. E. ROBBINS.—Greco-Egyptian arithmetical problems : P. Mich. 4966 95

G. SARTON.—GEORGE CATLIN (1796-1872) 77

Preface to Vol. XXII. Lusitanian memories . . . 440

P. A. SOROKIN and R. K. MERTON.—The course of Arabian intellectual development, 700-1300 A.D. 516

S. Mc C. STANTON.—The Admiral's map. What was it ? And who the admiral ? 511

D. V. THOMPSON, jr.—Medieval color-making : *Tractatus qualiter quilibet artificialis color fieri possit* 456
S. H. THOMSON.—The *Summa in VIII Libros Physicorum* of GROSSETESTE 12
M. C. WELBORN.—MONDINO DE 'LUZZI's commentary on the *Canones generales* of MESUË THE YOUNGER 8
J. R. WILLIAMS.—The Microcosmographia of Trier MS. 1041. 106

Fortieth critical bibliography of the history and philosophy of science and of the history of civilization (to January 1934*) (*650 *items contributed by* 11 *scholars).* 322

Forty-first critical bibliography of the history and philosophy of science and of the history of civilization (to April 1934*) (*345 *items contributed by* 6 *scholars)* 557

For Report (1), *Notes and correspondence* (20), *Reviews* (46), *see the summaries at the beginning of nos.* 63 *and* 64.

Contributors to this Volume.

C. W. ADAMS *(Hertford, England)*
R. C. ARCHIBALD *(Providence, R.I.)*
H. BÉVENOT *(Jerusalem)*
F. E. BRASCH *(Washington, D.C.)*
G. K. CHALMERS *(South Hadley, Mass.)*
H. T. DAVIS *(Bloomington, Ind.)*
T. L. DAVIS *(Cambridge, Mass.)*
A. DILLER *(Oxford)*
T. F. DUNN *(Saint-Louis)*
H. FRIEDENWALD *(Baltimore)*
S. GANDZ *(New York City)*
H. C. GREENE *(Cambridge, Mass.)*
E. W. GUDGER *(New York City)*
L. GUINET *(Brussels)*
W. H. HAMOR *(Pittsburgh, Pa.)*
L. HARAP *(Cambridge, Mass.)*
C. D. HELLMAN *(New York City)*
A. G. KAPP *(Koblenz)*
L. C. KARPINSKI *(Ann Arbor, Mich.)*
C. A. KOFOID *(Berkeley, Calif.)*
E. KREMERS *(Madison, Wisc.)*
S. V. LARKEY *(San Francisco, Calif.)*
C. D. LEAKE *(San Francisco, Calif.)*
M. C. LEIKIND *(Washington, D.C.)*
V. F. LENZEN *(Berkeley, Calif.)*
A. MARX *(New York City)*
R. S. MARX *(New York City)*
R. K. MERTON *(Cambridge, Mass.)*
M. MEYERHOF *(Cairo)*.
J. R. PARTINGTON *(London)*
C. H. PEAKE *(New York City)*
J. PELSENEER *(Brussels)*
B. PETRONIEVICS *(Belgrad)*
A. POGO *(Washington, D.C.)*
W. V. QUINE *(Cambridge, Mass.)*
F. E. ROBBINS *(Ann Arbor, Mich.)*
G. SARTON *(Cambridge, Mass.)*
P. A. SOROKIN *(Cambridge, Mass.)*
S. MC C. STANTON *(Ann Arbor, Mich.)*

D. STIMSON *(Baltimore, Md.)*
D. V. THOMPSON, JR. *(London)*
S. H. THOMSON *(Oxford)*
L. THORNDIKE *(New York City)*
H. R. VIETS *(Boston, Mass.)*
M. C. WELBORN *(Cambridge, Mass.)*
J. R. WILLIAMS *(Hanover, N. H.)*
E. WOLF *(Cambridge, Mass.)*
E. ZINNER *(Bamberg)*.

Authors whose books are reviewed :

BOAS, G.
BROWN, H.
CATTELL, J.
CATTELL, J. M.
CELLI, A.
COLIN, G. S.
DARWIN, C.
DATTA, B.
DICKINSON, H. W.
DINGLER, H.
FAGIN, N. B.
FARADAY, M.
FOURNIER, P.
FRANKLIN, K. J.
GINSBURG, J.
GLASSER, O.
HARRIS, H.
HURST, C. C.
JEANNIN, J.
KNONAU, G. M. v.
KURTZ, B. P.
LAGARDIÈR, A.
LAUNAY, L. DE.
MEDINA, J. T.
MEYER, A.
MEYERHOF, M.
MUMFORD, L.
NEWMAN, G.
PAULLIN, C. O.
PEARSON, K.
PEIRCE, C. S.
PTOLEMY
RENAUD, H. P. J.
RIGOBON, M.
ROULE, L.
SALLET, A.
SARTON, G.
SCHUSTER, J.
SINGER, C.
SKINNER, C. L.
SMITH, D. E.
SPARGO, J. W.
TITLEY, A.
VAN SCHEVENSTEEN, A. F. C.
WOLFSON, H. A.